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Economic Impact of Implementing RACT Guidelines in the State of Georgia

Booz-Allen and Hamilton, Inc, Florham Park, NJ

Prepared for

Environmental Protection Agency, Atlanta, GA Region IV

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16. ABSTRACT

The major objective of the contract effort was to determine the direct economic impact of implementing RACT standards in Georgia. The study is to be used primarily to assist EPA and Georgia decisions on achieving the emission limitations of the RACT standards.

The economic impact was assessed for the following RACT industrial categories: surface coatings (cans, paper, fabrics, automobiles, metal furniture and large appliances); solvent metal cleaning; bulk gasoline terminals; bulk gasoline plants; storage of petroleum liquids in fixed roof tanks; gasoline dispensing stations--Stage I; and use of cutback asphalt.

The scope of this project was to determine the costs and direct impact of control to achieve RACT guideline limitations for these 12 industry categories in Georgia. Direct economic costs and benefits from the implementation of RACT limitations were identified and quantified while secondary impacts (social, energy, employment, etc.) are addressed, they were not a major emphasis in the study.

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TASK ORDER NUMBER 6 UNDER:

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RESEARCH AND DEVELOPMENT SERVICES FOR ASSISTANCE
TO STATES AND EPA CARRYING OUT REQUIREMENTS
OF CLEAN AIR ACT AND APPLICABLE FEDERAL
AND STATE REGULATIONS

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION IV
Air and Hazardous Materials Division
Atlanta, Georgia

EPA PROJECT OFFICER: Winston Smith

from:

BOOZ, ALLEN & HAMILTON Inc.

May, 1979

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1. EXECUTIVE SUMMARY

This chapter summarizes the major elements and most significant findings of the study to determine the economic impact of implementing Reasonably Available Control Technology (RACT) guidelines for volatile organic compounds for twelve industrial categories in the state of Georgia. Further discussion and data are presented in detail in the subsequent chapters of the report. This Executive Summary is divided into three sections:

- Objectives, Scope and Approach
- Statewide Aggregate Economic Impact for the 15 RACT Guidelines
- Economic Implications of Each RACT Guideline.

1.1 OBJECTIVES, SCOPE AND APPROACH

The Clean Air Act Amendments of 1977 required the states to revise their State Implementation Plans (SIPs) to provide for the attainment and maintenance of national ambient air quality standards in areas designated as nonattainment. The Amendments require that each state submit the SIP revisions to the U.S. Environmental Protection Agency (EPA) by January 1, 1979. These proposed regulations should contain an oxident plan submission for major urban areas to reflect the application of Reasonably Available Control Technology (RACT) to stationary sources for which the EPA has published guidelines. The Amendments also require that the states identify and analyze the air quality, health, welfare, economic, energy and social effects of the plan provisions.

1.1.1 Objectives

The major objective of the contract effort was to assist the states in the determination of the direct economic impact of selected segments of their SIPs for six states (Alabama, Georgia, Kentucky, North Carolina, South Carolina and Tennessee) of Region IV of the U.S. Environmental Protection Agency. These studies will be used primarily to assist EPA decisions on achieving emission limitations.

1.1.2 Scope

The scope of this project for Georgia was to determine the costs and direct impacts of control to achieve RACT guideline limitations in twelve industrial categories. The impact was addressed for each industry and for each state so that the respective studies are applicable to individual state regulations. Direct economic costs and benefits from the implementation of the RACT guidelines were identified and quantified. While secondary (social, energy, employment, etc.) impacts were addressed, they were not a major emphasis in the study. In summary, direct economic impact analysis of each industrial category was aggregated on a statewide basis for the RACT categories studied.

In Georgia, the economic impact was analyzed for the implementation of RACT guidelines for the following 12 industry categories:

- Surface coating of metal cans
- Surface coating of paper
- Surface coating of fabrics
- Surface coating of automobiles and light duty trucks
- Surface coating of metal furniture
- Surface coating of large appliances
- Solvent metal cleaning
- Bulk gasoline terminals
- Bulk gasoline plants
- Storage of petroleum liquids in fixed roof tanks
- Service stations--Stage I
- Use of cutback asphalt.

The major study guidelines in the determination of the economic impact of the RACT guidelines are discussed below.

- The emission limitations for each industrial category was studied at the control level established by the RACT guidelines. These are presented in Exhibit 1-1, on the following page.

- All costs and emisssion data were presented for 1977.

- Emissions sources included were existing stationary point sources in most[1] of the applicable industrial categories with VOC emissions greater than 5 pounds in any hour or 50 pounds in any day in 12 counties that were classified as non-attainment for ozone.[2] In the rest of the state, only sources with greater than 100 tons/year of potential VOC emissions were included in the study.

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1. For two industrial categories (Service Stations and Solvent Metal Cleaning) size characteristics were used as the basis for inclusion, rather than emissions.

2. The non-attainment counties included: Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Fulton, Gwinnett, Henry, Paulding, Rockdale, and Muscogee (Columbus).

EXHIBIT 1-1(1)

U.S. Environmental Protection Agency
LISTING OF EMISSION LIMITATIONS THAT REPRESENT THE PRESUMPTIVE NORM TO BE ACHIEVED THROUGH APPLICATION OF RACT FOR FIFTEEN INDUSTRY CATEGORIES

Category	RACT Guideline Emission Limitations[a] Surface Coating Categories Based on Low Organic Solvent Coatings (lbs. solvent per gallon of coating, minus water)
Surface Coating Of:	
Cans	2.8
. Sheet basecoat (exterior and interior) Overvarnish Two-piece can exterior (basecoat and overvarnish)	
. Two and three-piece can interior body spray Two-piece can exterior end (spray or rollcoat)	4.2
. Three-piece can side-seam spray	5.5
. End sealing compound	3.7
Coils	
. Prime and topcoat or single coat	2.6
Paper	2.9
Fabrics and vinyl coating	
. Fabric	2.9
. Vinyl	3.8
Automobiles and Light Duty Trucks	
. Prime application, flashoff and oven	1.9
. Topcoat application, flashoff and oven	2.8
. Final repair application, flashoff and oven	4.8
Metal Furniture	
. Prime and topcoat or single coat	3.0
Magnet Wire	1.7
Large appliance	
. Prime, single or topcoat	2.8
Solvent Metal Cleaning	
. Cold cleaning	Provide cleaners with: cover; facility to drain clean parts; additional freeboard; chiller or carbon absorber. Follow suggested procedures to minimize carryout.
. Conveyorized degreaser	Provide cleaners with: refrigerated chillers; or carbon adsorption system; drying tunnel or rotating basket; safety switches; covers. Follow suggested procedures to minimize carryout.
. Open top degreaser	Provide cleaner with: safety switches; powered cover; chiller; carbon absorber. Follow suggested procedures to minimize carryout.
Petroleum Refinery Sources	
. Vacuum producing systems	No emissions of any noncondensible VOC from condensers, hot wells or accumulators to a firebox, incinerator or boiler.

EXHIBIT 1-1(2)
U.S. Environmental Protection Agency

Category	RACT Guidelines Emission Limitations[a]
. Wastewater separators	Minimize emissions of VOC by providing covers and seals on all separators and forebays and following suggested operating procedures to minimize emissions
. Process unit turnaround	Minimize emissions of VOC by depressurization venting to vapor recovery, flare or firebox. No emissions of VOC from a process unit or vessel until its internal pressure is 136 kilo Pascals (17.7 psia) or less
Bulk Gasoline Terminals	Equipment such as vapor control system to prevent mass emissions of VOC from control equipment to exceed 80 milligrams per liter (4.7 grains per gallon) of gasoline loaded
Bulk Gasoline Plants	Provide submerged filling and vapor balancing or equivalent control to reduce VOC emissions. Follow suggested procedures to minimize vapor losses.
Storage of Petroleum Liquids in Fixed Roof Tanks	Provide single seal and internal floating roof to all fixed roof storage vessels with capacities greater than 150,000 liters (39,000 gal.) containing volatile petroleum liquids for which true vapor pressure is greater than 10.5 kilo Pascals (1.52 psia)
Service Stations (Stage I)	Provide submerged fill and vapor balance for any stationary storage tank located at a gasoline dispensing facility with a capacity of 7,500 liters (2,000 gal.) or greater which is in place before January 1, 1979, or any stationary storage tank located at a gasoline dispensing facility with a capacity of 948 liters (250 gal.) or more which is in place before January 1, 1978. Follow suggested procedure to minimize vapor losses
Use of Cutback Asphalt	The manufacture, mixing, storage, use or application may be approved where: long-life stockpile storage is necessary; the use or application is an ambient temperature less than 10°C (50°F) is necessary; or it is to be used solely as a penetrating prime coat

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Note: An alternative scenario to the recommended RACT guidelines for surface coating of automobiles is also studied. It assumes that the timing requirements and possible limitations are modified to meet developing technologies.

a. Annotated description of RACT guidelines

Source: Regulatory Guidance for Control of Volatile Organic Compound Emissions from 15 Categories of Stationary Sources, U.S. Environmental Protection Agency, EPA-90512-78-001, April 1978.

- Service stations, bulk plants, solvent metal cleaning, and the use of cutback asphalt were studied for the 12 non-attainment counties only.
- The following volatile organic compounds were exempted:
  - Methane
  - Ethane
  - Trichlorotrifluorethane (Freon 113)
  - 1,1,1-trichloroethane (methyl chloroform).[1]
- The timing requirement for implementation of controls to meet RACT emission limitations was January 1, 1981 for cutback asphalt and July 1, 1982 for the other industry categories.

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[1] The exemption status of methyl chloroform under these guidelines may be subject to change.

1.1.3 Approach

The approach applied to the overall study was: a study team with technology and economic backgrounds utilized available secondary sources to estimate the emissions, statistics and costs for each RACT industrial category; then, the study team completed, calibrated and refined these estimates based on interviews with industry representatives in the state.

Because of the number of point sources and the data available in the state emission inventory, the methodology was specific for each RACT industrial category studied. However, the general methodology applied for two major classes of industrial categories was:

- Surface coating RACT industrial categories (cans, fabrics, paper, automobles and light duty trucks, metal furniture and large appliances)--The potentially affected facilities and emissions were obtained primarily from the Georgia Department of Natural Resources and interviews. Therefore, the following general methodology was applied:
  - A list of potentially affected facilities was compiled from secondary reference sources.
  - Data from the Georgia emission inventory were categorized and compiled for each RACT industrial category by the Georgia Department of Natural Resources.
  - Firms not listed in the emission inventory were identified. All of these facilities were then interviewed by the Georgia Department of Natural Resources when there was doubt concerning their inclusion.
  - Emissions, emission characteristics, control options and control costs were studied for relevant firms.
  - Interviews were conducted by Booz, Allen to determine emissions (when not available), applicable control options and potential control costs.
  - The study team then evaluated the control cost to meet the RACT requirements and the potential emission reduction.

- Nonsurface coating RACT industrial categories (bulk gasoline plants, bulk gasoline terminals and refineries, service stations, fixed roof tanks and solvent metal cleaning)--Each category either represented an exhaustive list of potentially affected facities or emissions data were not available (or categorized) for these types of sources. Therefore, the following generalized methodology was applied:
    - Industry statistical data were collected from secondary reference sources.
    - The Georgia Department of Natural Resources identified facilities which would be affected by the proposed regulation for bulk gasoline plants, terminals and fixed roof tanks.
    - Emissions were estimated by applying relevant factors (e.g., emissions per facility or throughput) which have been determined by the EPA.
    - Control options and estimated costs to meet the RACT guidelines were reviewed.
    - Interviews were conducted to determine applicable associated control options and the cost of control.

1.1.4 Quality of Estimates

The quality of the estimates that are presented in this report can be judged by evaluating the basis for estimates of the individual study components. In each of the chapters that deal with the development of estimated compliance cost, the sources of information are fully documented. In addition, the study team has categorically ranked by qualitative judgment the overall data quality of the major sources and, therefore, of the outcomes. These data quality estimates were ranked into three categories:

- High quality ("hard data")--study inputs with variation of not more than ± 25 percent
- Medium quality ("extrapolated data")--study inputs with variation of ± 25 to 75 percent
- Low quality ("rough data")--study inputs with variation of ± 50 to 150 percent.

Each of these data quality estimates is presented in the individual chapters. The overall quality ranking of the study inputs for each RACT industrial category was generally in the medium quality range.

1.2 STATEWIDE AGGREGATE ECONOMIC IMPACT FOR THE TWELVE RACT GUIDELINES

The implementation of RACT emission limitations for 12 industrial categories in Georgia involves an estimated $182 million capital cost and $29 million annualized cost per year. The net VOC emission reduction is estimated to be 43,000 tons annually from a 1977 baseline of 54,000 tons. Exhibit 1-2, on the following page, presents a quantitative summary of the emissions, estimated cost of control, cost indicators and cost effectiveness of implementing RACT guidelines for 12 industrial categories.[1]

- Approximately 6,750 facilities are potentially affected by the 12 RACT guidelines in Georgia.
  - Ninety-eight percent of the potentially affected facilities are represented by the solvent metal cleaning (2,300 facilities) and service station (4,325 facilities) industrial categories.
  - Less than 1 percent (26 facilities) of the potentially affected facilities are represented by the six surface coating industrial categories (cans, paper, fabrics, automobiles, metal furniture and large appliances).
- In 1977, the estimated annual VOC emissions (including those already controlled) for the 12 RACT industrial categories totalled approximately 54,000 tons.
  - Four gas marketing categories (tank truck loading terminals, bulk gas plants, fixed roof tanks and service stations) represented 51 percent of the total VOC emissions.
  - Solvent metal cleaning represented 9 percent of the total VOC emissions (from the 12 RACT categories studied).

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[1] An alternative scenario for the surface coating of automobiles is also presented in the text of Chapter 7. The EPA recommended RACT limitations for automobile assembly plants represent a waterborne topcoat system which would require extensive modification of the current production lines. Under the alternative scenario, it is assumed that RACT timing requirements and possibly limitations are modified to meet developing technologies that are more cost and energy effective.

EXHIBIT 1-2
U.S. Environmental Protection Agency
SUMMARY OF IMPACT OF IMPLEMENTING RACT
GUIDELINES IN 12 INDUSTRIAL CATEGORIES -- GEORGIA

	Emissions				Cost of RACT Control		Cost Indicators		Cost Effectiveness
Industry Category	Number of Facilities Potentially Affected	1977 VOC Emissions (tons/yr.)	Estimated VOC Emissions After Implementing RACT (tons/yr.)	Net VOC Emission Reductions (tons/yr.)	Capital Cost[a] ($ millions)	Annualized Cost (credit) ($ millions)	Annualized Cost as Percent of Value of Shipments[b] (percent)	Annualized Cost Per Unit Shipment (cost per unit)	Annualized Cost (credit) Per Ton of VOC Reduction ($ per tons/yr.)
Surface coating of cans	6	3,210	820	2,390[c]	1.5	0.5	0.2	$0.0001/can	230
Surface coating of paper	9	1,411	322	1,089	3.8	0.445	1.8	-	405
Surface coating of fabrics	0	-	-	-	-	-	-	-	-
Surface coating of automobiles	3	13,700	2,300	11,400	160	27	0.9	$45/auto	2,360
Surface coating of metal furniture	3	365	80	285	0.264	Up To (0.010)	(0.02)	-	Up To (35)
Surface coating of large appliances	5	280	84	196	0.150	0.035	0.05	$0.25/ household unit	175
Solvent metal cleaning	2,300	4,800	3,700	1,100	1.1	0.14	<0.01	NA	127
Tank truck gasoline loading terminals	33	20,396	2,040	18,356	10.114	(0.039)	(0.001)	Negligible	(1.71)
Bulk gasoline plants	35	733	147	586	0.503	0.132	0.48	$0.0048/gal.	225
Storage of petroleum liquids in fixed roof tanks	31	2,376	138	2,238	2.11	0.307	0.20	<$0.001/gal.	144
Service Stations (Stage I)	4,325	4,026	201	3,825	2.742	0.686	0.13	$0.0007/gal.	170
Cutback Asphalt	d	2,640	1,190	1,450	0.06	NA	NA	NA	NA
TOTAL	6,750	53,937	11,022	42,915	182.34	29.2			

Note: Figures presented in this exhibit are rounded and approximated for comparison purposes.

a. Includes one time costs
b. Value of shipments represents the total value in the specific industry category for the state being studied.
c. This represents emissions after control due to RACT and industry changes to print-only (not resulting from RACT.)
d. Estimate use of cutback asphalt in 1977 was 12,800 tons.

Source: Booz, Allen & Hamilton Inc.

  - Use of cutback asphalt represented 5 percent of the total VOC emissions.
  - Six surface coating categories represented 35 percent of the total VOC emissions.

- The net emission reduction achievable by implementing the 12 RACT guidelines is estimated to be approximately 43,000 tons annually. The approximate percent of the total VOC emissions reduced by implementing RACT by industrial category group is:
  - Gas marketing categories--53 percent of VOC emission reduction
  - Surface coating categories--36 percent of VOC emission reduction
  - Use of cutback asphalt--3 percent of VOC emission reduction
  - Solvent metal cleaning category--3 percent of VOC emission reduction.

- The capital cost for the twelve industrial categories to achieve the RACT guidelines is estimated to be $182 million.
  - Approximately 88 percent of the total estimated capital cost is for control of automobile assembly plants. The capital required to meet RACT guidelines for automobile surface coating is estimated to be $160 million. (An alternative scenario to the recommended RACT limitations for automobiles was also studied. This alternative scenario would represent an estimated capital cost of $43 million.)
  - The four industrial categories dealing with petroleum marketing (bulk gasoline plants, bulk gasoline terminals, fixed roof tanks and service stations) account for approximately $15 million (or 8 percent of the total) of the estimated capital cost.

- The annualized cost of the twelve RACT industrial categories to achieve the RACT guidelines is estimated to be $29 million. The control of automobile assembly plants is estimated to be $27 million annualized cost (the alternative scenario for auto assembly was an estimated annualized cost of $6 million). In terms of cost indicators, the annualized compliance cost per value of shipments will have the largest effect on the following industrial categories:

  - Paper coating--The annualized costs represent approximately 1.8 percent of the 1977 affected industry's value of shipments.

  - Surface coating of automobiles--The annualized compliance costs represent approximately 0.9 percent of 1977 statewide value of shipments.

  - Bulk gasoline plants--The annualized compliance costs represent approximately 0.5 percent of the 1977 statewide value of shipments.

- Technology developments and delivery of equipment could present problems in achieving the 1982 timing requirements in some of the RACT guidelines.

  - The recommended RACT guidelines for automobile assembly plants would require a waterborne topcoating. Manufacturers could not convert facilities on a nationwide basis to waterborne topcoat systems by the 1982 timeframe.

  - Low solvent coating technology requires some further development for cost- or energy-effective implementation of the RACT guidelines in the following industrial categories:

    - Surface coating of automobiles

    - Surface coating of large appliances

    - Surface coating of cans (end sealing compound)

    - Surface coating of metal furniture (full color line).

  - Equipment delivery and installation of control equipment were identified as potential problems on a nationwide basis in the following industrial categories:

    - Surface coating of paper
    - Solvent metal degreasing
    - Tank truck gasoline loading terminals
    - Gasoline service stations.

- The implementation of the RACT guidelines is expected to create further concentration for some industrial sectors requiring major capital and annualized cost increases for compliance. RACT requirements may have the effect of being another contributing factor to the industry trends of high throughput facilities in the following RACT industrial categories:

  - Bulk gasoline plants
  - Service stations.

- The annualized cost of compliance for the four gasoline marketing categories is estimated to be approximately $1 million. Assuming a "direct cost pass-through" for the affected facilities (the 12 non-attainment county area) the annualized cost would represent a price increase of 0.1 cents per gallon. This cost analysis assumes that vapors collected at the service station are recovered eventually at bulk terminals and refineries. To the extent that some service stations having controls may purchase gasoline from bulk gasoline plants (outside the 12 county non-attainment area) without vapor collection equipment, the product recovered may be overstated.

- The implementation of the RACT guidelines for the twelve industrial categories is estimated to represent a net energy savings of 16,600 equivalent barrels of oil annually as shown in Exhibit 1-3, on the following page. Assuming a value of oil at $13 per barrel, this is an equivalent energy savings of $215,000 annually.

  - RACT compliance requirement for five of the surface coating industrial categories (cans, paper, fabrics, metal furniture and large appliances) represent a net energy demand of approximately 3,500 equivalent barrels of oil annually.

EXHIBIT 1-3

U.S. Environmental Protection Agency

ESTIMATED CHANGE IN ENERGY DEMAND RESULTING FROM IMPLEMENTATION OF 12 RACT GUIDELINES IN GEORGIA

Industry Category	Energy Demand Change Increased (Decrease) (Equivalent barrels of oil)	Energy Demand Change Cost/(Savings)[a] ($ million)
Surface coating of cans	2,000	0.026
Surface coating of paper	7,300	0.095
Surface coating of fabrics	-	-
Surface coating of automobiles	150,000	1.95
Surface coating of metal furniture	(5,000)	(0.065)
Surface coating of large appliances	(800)	(0.010)
Solvent metal cleaning	Negligible	Negligible
Tank truck gasoline loading terminals	(125,000)	(1.625)
Bulk gasoline plants	(4,000)	(0.052)
Storage of petroleum liquids in fixed roof tanks	(13,000)	(0.169)
Service stations (STAGE I)	(26,000)	(0.337)
Use of cutback asphalt	(2,900)	(0.37)
TOTAL	(16,600)	(0.215)

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a. Based on the assumption that the cost of oil is $13 per barrel.

Source: Booz, Allen & Hamilton Inc.

- RACT compliance requirements for the four industrial categories dealing with petroleum marketing (service stations, bulk gasoline terminals, bulk gasoline plants and tank truck gas loading terminals) represent a net energy savings of approximately 168,000 barrels of oil annually. However, the feasibility of control efficiency has not been totally demonstrated and these estimates are likely to overstate the achievable energy savings for bulk gasoline plants and service stations.

- RACT compliance requirements for automobile assembly plants to convert to waterborne topcoat represents a net energy demand of approximately 150,000 equivalent barrels of oil annually. However, the alternative scenario studied is not energy intensive.

In 1977, the statewide value of shipments of the twelve industrial categories potentially affected by RACT was $7.3 billion, which represents approximately 23 percent of Georgia's total value of shipment of manufacturing goods. The estimated annualized cost of implementing the RACT guidelines ($29 million) represents 0.4 percent of the value of shipments for the twelve RACT industrial categories affected. The annualized cost represents 0.09 percent of the statewide total value of shipment of all manufactured goods.

1.3 ECONOMIC IMPLICATIONS OF EACH RACT GUIDELINE

This section presents a summary of the economic impact for each of the 12 RACT industrial categories studied. Following this section is a series of summary exhibits which highlight the study findings for each industrial category.

1.3.1 Surface Coating of Cans

Currently there are six major can coating facilities in the state of Georgia. Three of the major can assembly plants in Georgia are located near Atlanta.

The industry preferred method of control to meet the RACT requirements is to convert to low solvent (waterborne) coatings. However, low solvent coatings for end sealing compounds are presently not available and may not be available by 1982. To meet the RACT requirements, can manufacturers may convert three-piece can lines to waterborne coatings or install thermal incineration for controlling high solvent coatings. In addition, some three-piece can facilities may convert to two-piece for economic or market reasons which would have the effect of lower VOC emissions.

Emission controls are expected to cost the industry $1.5 million in capital and $0.5 million in annualized cost. This represents approximately 0.2 percent of the affected industry's value of shipments. No major employment, productivity or market structure changes are expected from the implementation of the RACT guidelines.

The industry trend towards production of two-piece aluminum cans with print-only coatings (rather than print and varnish) is predicted to continue because of economic advantages and market demands. The conversion to print-only technology will reduce current VOC emissions. Because the industry is planning to convert some facilities to print-only technology in the near term, associated economic advantages of the conversion have not been included in the economic analysis of the RACT requirements.

1.3.2 Surface Coating of Paper

This study covered nine plants identified from the RACT requirements for paper coaters. Excluded from this study are facilities engaged in publishing, who may coat paper as a segment of the processing line. The study assumes that these facilities would fall under other RACT guidelines currently being developed, such as Graphic Arts. Further definition of the paper coating category should be established prior to enforcement.

The retrofit situations and installation costs for add-on controls are highly variable. Based on these variations, the estimated capital cost to the industry is between $3.4 million and $4.1 million, with an annualized cost of $0.4 million to $0.5 million (approximately 1.8 percent of the statewide value of shipments).

Assuming 70 percent heat recovery, the annual energy requirements are expected to increase by approximately 7,300 equivalent barrels of oil per year. Energy consumption may decrease if further efficient recovery of incinerator heat is possible.

Incinerator equipment manufacturers have stated that there may be significant problems in meeting the anticipated demand for high heat recovery incinerators on a nationwide basis.

1.3.3. Surface Coating of Fabrics

None of fabric coating facilities in Georgia are anticipated to incur major economic costs to meet the RACT requirements. A preliminary list of 43 facilities were identified as potentially being affected by the RACT requirements. Interviews with all of these firms revealed that either the facilities would not be subject to the RACT requirements (i.e., they were not coaters of fabric or they utilized spray or extrusion methods of coating) or the facilities utilized latex coating materials. Therefore, although there may be some associated costs for RACT compliance (monitoring, recordkeeping, etc.) no major costs or emission reductions are anticipated for this RACT industrial category.

1.3.4 Surface Coating of Automobiles

There are two major companies operating three automobile assembly plants in Georgia. Of all states, Georgia ranks sixth in automobile production. The EPA recommended RACT guidelines would require conversion to waterborne paints. However, the EPA is currently considering some modifications of the RACT requirements for automobile assembly plants. Therefore, two scenarios of RACT guidelines were studied:

Scenario I--Current RACT limitations implemented by 1982. Under this scenario it is assumed that automobile assembly plants will convert facilities to the following available paint technologies to meet the RACT requirements:

- Cathodic electrodeposition for prime coat
- Waterborne enamels for topcoat
- High solids enamels for final repair.

The implementation of these technologies would require extensive modification to the three facilities in Georgia. The capital required would be approximately $160 million. The estimated annualized compliance cost is $27 million and would represent an increased energy demand of approximately 150,000 barrels of oil annually. If this increased cost were passed on directly, it would represent an increase in price of $45 per automobile manufactured. These major modifications would require approximately three to four years for completion; and, although possibly achievable in Georgia, all assembly plants in the U.S. could not convert to these technologies by 1982.

Scenario II--RACT timing requirements and possibly limitations are modified to meet developing technologies. Under this scenario it is assumed that automobile assembly plants will develop and apply the following paint technologies:

- Cathodic electrodeposition for prime coat
- High solids enamels, urethane enamels, powder coating or equivalent technologies for topcoat
- High solids enamels for final repair.

The major area of modification in this scenario is the technology applied for topcoat paints. Under this scenario, it it assumed that the RACT limitations could not be achieved by the 1982 timeframe. It is assumed that manufacturers currently using enamel paints would develop higher solids enamels that would approach or achieve the emission reduction of waterborne paints. The capital requirements for Scenario II are estimated to be $43 million. The estimated annualized compliance cost is $6 million. If this increased cost were passed on directly, it would represent an increase in price of $10 per automobile manufactured.

1.3.5 Surface Coating of Metal Furniture

There are three facilities in Georgia identified as manufacturers and coaters of metal furniture, which would be affected by the proposed limitations for the RACT industrial category. None of the facilities currently have controls which would meet the proposed limitations.

To meet the RACT requirements, these facilities will need to invest approximately $260,000 in capital, and the annualized savings of control could be up to $10,000.

No significant productivity, employment or market structure dislocations should be associated with the implementation of the RACT guidelines.

To meet the RACT requirements, the low solvent coating materials may not totally be available in the quality, color variety or specifications of each of the manufacturers. The development of totally suitable coating materials (or changes in current manufacturing requirements) is the key to successful implementation of the RACT requirements within the given time limitations.

1.3.6 Surface Coating of Large Appliances

There are five large appliance manufacturing facilities in Georgia, but only one is expected to be affected by the RACT guidelines. This manufacturer would be required to invest approximately $75,000 in capital and incur additional annualized costs of $35,000 (approximately 0.05 percent of industry statewide value of shipments).

Assuming a "direct cost pass-through," the cost increase for household appliances relates to a price increase of approximately $0.25 per unit. No major productivity, employment or market structure dislocations appear to be associated with implementation of the RACT guidelines.

The high solids (greater than 62 percent by volume) top-coat application technique preferred by the industry has not been proven under normal operating conditions although it appears to be technically feasible.

1.3.7 Solvent Metal Cleaning

This category includes equipment to clean the surface for removing oil, dirt, grease and other foreign material by immersing the article in a vaporized or liquid organic solvent. The cleaning is done in one of three devices: a cold cleaner, an open top vapor degreaser, or a conveyorized degreaser. This type of cleaning is done by many firms in many different types of industries.

Implementation of the proposed RACT guidelines for the 12 county areas in Georgia will affect an estimated 2,300 facilities. The regulation is expected to have a negligible economic effect on industry because of the relatively minor changes required. For Georgia, the 2,300 facilities potentially affected represent a capital cost of $1.1 million and an annualized cost of $0.14 million (<0.01 percent of industry value of shipments).

Because of the large number of degeasers nationwide that require retrofit to meet RACT and the inability of manufacturers to provide equipment on such a large scale, it is doubtful if all degreasers nationwide can be retrofitted within the 1982 timeframe.

No major productivity, employment and market structure dislocations will result from RACT implementation.

1.3.8 Tank Truck Gasoline Loading Terminals

There are 33 facilities identified in the state of Georgia as tank truck gasoline loading terminals and affected by the limitation requirements. Emission control of these facilities is expected to require a capital investment of $6.0 million. Product recovery of gasoline will be accrued to bulk terminal operations not only from bulk terminal emission control installations but also from the recovery of vapors from service stations and bulk gasoline plants. This recovery represents an annual product savings of over $34 million. Based on this savings, the net annualized credit for implementation of RACT for bulk gasoline loading terminals is estimated to be $40,000.

No significant productivity, employment or market structure dislocations should be associated with implementing the RACT guidelines.

1.3.9 Bulk Gasoline Plants

This industry is characterized by many small plants. Of these plants, only a few percent are either new or modernized. The majority of the plants are over 20 years old. Most bulk plants are located in rural areas where implementation of RACT to stationary sources is not required in the state of Georgia.

To meet the RACT requirements, 35 bulk gas plants in the nonattainment areas must be equipped with vapor balance and submerged fill systems. This recommended control system is not cost-effective for the bulk plant operator as most of the economic credit (for recovered vapors) would be accrued to a bulk terminal or refinery.

The estimated capital cost and annualized cost to meet compliance requirements for the 35 facilities represent $0.5 million and $0.13 million (approximately 0.5 percent of affected industry's value of shipments), respectively. The compliance costs may create market price increase. For these facilities, the price of gasoline (assuming a "direct cost pass-through") would be increased $0.005 per gallon. Because of the competitiveness and low profit structure in the industry, further cost increases could force some marginal operations out of the business, thus further concentrating the market structure. In urban areas, the bulk gasoline plant markets have been declining because of competition from retailers and tank truck terminals, and will continue to decline regardless of the RACT guidelines.

1.3.10 Storage of Petroleum Liquids in Fixed Roof Tanks

There are an estimated 31 fixed roof tanks (27 in the 12 county nonattainment areas) in the state of Georgia which would have to be equipped with a internal floating roof to comply with the proposed RACT requirements. These VOC emissions (1977) for these tanks are estimated to be over 2,100 tons.

These tanks are primarily owned by major oil companies and bulk gasoline tank terminal companies. The capital cost to equip these tanks with a single seal floating roof is estimated to be $2.1 million. The estimated annualized cost is $0.3 million, which would represent a price increase (assuming "direct cost pass-through") of less than $0.001 per gallon of throughput.

No significant productivity, employment or market structure changes should be associated with the implementation of the RACT guideline.

Implementation of the RACT guideline is estimated to represent a net energy savings of $17,000 equivalent barrels of oil annually (assuming 90 percent control efficiency).

1.3.11 Service Stations

There are approximately 4,300 service stations located in the 12 county nonattainment areas of Georgia. The implementation of submerged fill and vapor balancing at these stations is estimated to be $2.5 million in capital. In addition, tank trucks supplying these stations must be equipped with appropriate vapor control modifications for top submerged fill or bottom fill. The capital cost to equip the existing fleet (not including those tanks owned by the affected bulk plant and terminal RACT requirements) is estimated to be $0.2 million. Therefore, the total capital requirement is estimated to be $2.7 million and the annualized cost is estimated to be $0.53 million. This annualized cost represents an average cost increase of approximately $0.001 per gallon; however, larger stations will experience a much smaller unit cost increase. The service stations could experience loss of business while vapor control systems are being installed.

Implementation of the RACT guidelines may accelerate the trend to high throughput stations because of the increasing overhead costs. However, the RACT guidelines will not cause major productivity and employment dislocations to the industry as a whole.

It is estimated that implementing RACT guidelines for service stations in Georgia will result in a net energy savings equivalent to 26,000 barrels of oil per year, assuming 95 percent recovery of gasoline. This assumed control efficiency has not been fully demonstrated. Only a small percent of the economic benefit from the recovered gasoline vapors will directly accrue to the service stations.

1.3.12 Use of Cutback Asphalt

In 1977, it is estimated that 12,800 tons of cutback asphalt was utilized in the nonattainment areas of Georgia. Replacement of the solvent-based asphalt with asphalt emulsion will cause no dislocation in employment or worker productivity. Capital and training cost investment is estimated at $60,000. No change in paving costs are expected from the implementation of the RACT guideline.

It is anticipated that sufficient lead time is available to assure an adequate supply of asphalt emulsion to meet the increased demand and provide training for municipal employees.

* * * *

A summary of the direct economic implications of implementing RACT in each of the 12 industrial categories studied is presented in Exhibits 1-4 through 1-15, on the following pages.

EXHIBIT 1-4

U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR CAN MANUFACTURING PLANTS IN THE STATE OF GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	There are six can manufacturing facilities
Indication of relative importance of industrial section to state economy	The 1977 value of shipment was about $290 million.
Current industry technology trends	Beer and beverage containers rapidly changing to two-piece construction
VOC emissions	3,200 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Low solvent coatings (waterborne) with incineration as an interim approach for older facilities
Affected Areas in Meeting RACT	
Capital investment (statewide)	$1.5 million
Annualized cost (statewide)	$10.5 million
Price	Assuming a direct pass-through of costs, no significant change in price
Energy	2,000 equivalent barrels of oil annually to operate incinerators
Productivity	No major impact
Employment	No major impact
Market structure	Accelerated technology conversion to two-piece cans
Problem area	Low solvent coating technology for end sealing compound
VOC emission after control	820 tons per year (25 percent of current emission level)[a]
Cost effectiveness of control	$230 annualized cost/annual ton of VOC reduction from current level of control

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[a] This represents emission after control due to RACT and industry changes to print-only (not resulting from RACT), 330 tons of the reduction is credited to print-only change.

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 1-5

U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR PAPER COATERS IN THE STATE OF GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	Three plants in Georgia are expected to suffer major impact under these regulations. However, if this category is interpreted to include all types of paper coating, including publishing, far more firms would be affected
Indication of relative importance	The 1977 value of shipments of these is estimated to be $25 million. These plants are estimated to employ 300 employees
Current industry technology trends	Gravure coating replacing older systems
1977 VOC emissions (actual)	Approximately 1,411 tons per year were identified from the emission inventory
Industry preferred method of VOC control to meet RACT guidelines	Use of solventless systems is increasing and several plants in Georgia have converted to them
Assumed method of control to meet RACT guidelines	Thermal incineration with primary heat recovery and carbon adsorption
Affected Areas in Meeting RACT	**Discussion**
Capital investment (statewide)	Estimated to be 3.4 million to 4.1 million depending on retrofit situations. This is likely to be more than 100 percent of normal expenditures for the affected paper coaters
Annualized cost (statewide)	$385,000 to $505,000 annually. This may represent 1.5 to 2.0 percent of the 1977 annual sales for the affected paper coaters
Price	Assuming a "direct cost pass-through"--1.5 to 2.0 percent
Energy	Assuming 70 percent heat recovery annual energy requirements are expected to increase by approximately 7,000 equivalent barrels of oil annually
Productivity	No major impact

EXHIBIT 1-5 (2)
U.S. Environmental Protection Agency

Affected Areas in Meeting RACT	Discussion
Employment	No major impact
Market structure	No major impact
RACT timing requirements (1982)	RACT guideline needs clear definition for rule making
	Nationwide equipment deliverables and installation of incineration systems prior to 1982 are expected to present problems
Problem areas	Retrofit situations and installation costs are highly variable
	Type and cost of control depend on particular solvent systems used and reduction in air flow
VOC emissions after control	270 tons/year (20 percent of 1977 VOC emission level)
Cost effectiveness of control	$350-$460 annualized cost/annual ton of VOC reduction

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 1-6

U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT SCENARIO I FOR AUTOMOBILE ASSEMBLY PLANTS IN THE STATE OF GEORGIA

SCENARIO I
(RACT Limitations
Implemented By 1982)

Current Situation	Discussion
Number of potentially affected facilities	Two companies operating three facilities
Indication of relative importance of industrial sector to state enconomy	1977 value of shipments was approximately $3.5 billion, which represents approximately 10 percent of the state's manufacturing industry. Of all states, Georgia ranks sixth in automobile production
Current industry technology trends	Prime coat--cathodic electrodeposition topcoats--higher solids enamels for manufacturers using enamel systems
1977 VOC emissions (actual)	13,700 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Cathodic electrodeposition for prime coat; manufacturers with enamel topcoat--high solids enamel; manufacturers with lacquer topcoat--unkown
Assumed method of control to meet RACT guidelines	Cathodic electrodeposition for prime coat Waterborne enamels for topcoat High solids enamels for final repair

Affected Areas in Meeting RACT Scenario I	Discussion
Capital investment (statewide)	$160 million (approximately 300 percent of current annual capital expenditures for the industry in the state)
Annualized cost (statewide)	$27 million (approximately 0.9 percent of the industry's 1977 statewide value of shipments)
Price	Assuming a "direct cost pass-through" approximately $45 per automobile manufactured
Energy	Increase of 150,000 equivalent barrels of oil annually primarily for operation of waterborne topcoating systems
Productivity and employment	Conversion to waterborne systems would require total rework of existing processing lines. Major modifications would probably increase efficiency and line speed of older units.
Market structure	Accelerated technology conversion to electrodeposition primer coat.

EXHIBIT 1-6 (2)
U.S. Environmental Protection Agency

SCENARIO I
(RACT Limitations
Implemented By 1982)

Current Situation	Discussion
RACT timing requirements (1982)	Conversion of all automobile assembly plants to topcoating waterborne systems cannot be achieved by 1982 Prime coat RACT limitations are based on anodic electrodeposition systems and need to be modified to reflect cathodic processing. Topcoat RACT limitations are based on waterborne coatings, which is not a cost or energy effective alternative. Final repair RACT limitations areas based on high solids enamel technology which would require major modifications for manufacturers using lacquer systems
VOC emission after RACT control	2,300 tons per year (17 percent of 1977 emission level)
Cost effectiveness of RACT control	$2,360 annualized cost/annual ton of VOC reduction

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 1-7

U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS
OF IMPLEMENTING RACT SCENARIO II FOR
AUTOMOBILE ASSEMBLY PLANTS IN THE
STATE OF GEORGIA

SCENARIO II

(RACT Timing Requirements And
Possible Limitations Are Modified
To Meet Developing Technologies)

Current Situation	Discussion
Number of potentially affected facilities	Two companies operating three facilities
Indication of relative importance of industrial section to state enconomy	1977 value of shipments was approximately $3.5 billion which represents approximately 10 percent of the state's manufacturing industry. Of all states, Georgia ranks sixth in automobile production
Current industry technology trends	Prime coat--cathodic electrodeposition topcoats--higher solids enamels for manufacturers using enamel systems
1977 VOC emissions (actual)	13,700 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Cathodic electrodeposition for prime coat; manufacturers with enamel topcoat--high sales enamel; manufacturers with lacquer topcoat--unknown
Assumed method of control to meet RACT guidelines	Cathodic electrodeposition for prime coat High solids enamels, urethane enamels or powder coating for topcoat High solids enamel for final repair

Affected Areas in Meeting RACT Scenario II	Discussion
Capital investment (statewide)	$43 million (approximately 80 percent of current annual capital appropriations for the industry in the state)
Annualized cost (statewide)	$6 million (approximately 0.2 percent of the industry's 1977 statewide value of shipments)
Price	Assuming a "direct cost pass-through" approximately $10 per automobile manufactured
Energy	Dependent on technology applied
Productivity and employment	No major effect
Market structure	No major effect--however, General Motors is likely to have higher conversion costs to developing technologies
RACT timing requirements	Primer and final repair limitations could be implemented at most facilities by 1982 Topcoat limitations could be set at a 40 percent to 62 percent solids by 1985 dependent on technology developments
Problem area	Limitations for topcoat are dependent on technology development
VOC emission after RACT control	2,300-6,800 tons per year (17 percent to 50 percent of 1977 emission levels dependent on limitations)
Cost effectiveness for RACT control	$525-$870 annualized cost/annual ton VOC reduction

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 1-8

U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC INPLICATIONS OF IMPLEMENTING RACT FOR SURFACE COATING OF METAL FURNITURE IN GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	There are 3 metal furniture manufacturing facilities
Indication of relative importance of industrial section to state economy	1977 value of shipments was between $30 million and $60 million industry-wide and approximately $18.5 million for three affected facilities
Current industry technology trends	Trend is towards the use of a variety of colors
1977 VOC emissions (actual)	365 tons per year
Industry preferred method of VOC control	Low solvent coatings
Assumed method of control to meet RACT guidelines	Low solvent coatings

Affected Areas in Meeting RACT	Discussion
Capital investment (statewide)	$264,000
Annualized savings (statewide)	Up to $10,000
Price	No major change
Energy	Savings of 5,000 equivalent barrels of oil per year
Productivity	No major impact
Employment	No major impact
Market structure	No major impact
RACT timing requirements (1982)	Companies using a variety of colors may face a problem finding suitable low solvent coatings
Problem area	Low solvent coating in a variety of colors providing acceptable quality needs to be developed
VOC emissions after RACT	80 tons per year (approximately 22 percent of current emissions level)
Cost effectiveness of RACT	Up to $35 annualized savings/ annual ton of VOC reduction

Source: Booz, Allen & Hamilton Inc.

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EXHIBIT 1-9
U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR SURFACE COATING OF LARGE APPLIANCES IN THE STATE OF GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	There are five major large appliance manufacturers and coaters, only one of which will be affected by the guidelines
Indication of relative importance of industrial section to state economy	1977 statewide value of shipments was estimated at $75 million and represents 0.5 percent of the estimated $15 billion U.S. value of shipments of the major appliance industry
1977 VOC emissions (actual)	280 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Waterborne primecoat and high solids topcoat
Assumed method of VOC control to meet RACT guidelines	Waterborne primecoat and high solids topcoat

Affected Areas in Meeting RACT	Discussion
Capital investment (statewide)	$150,000
Annualized cost (statewide)	$35,000 which represents 0.05 percent of the industry's 1977 statewide value of shipments.
Price	Assuming a "direct cost pass-through"--increase of $0.25/unit for household appliances (based on an average price of $240 per unit appliance)
Energy	Reduced natural gas requirements in the curing operation (equivalent to 800 barrels of oil per year)
Productivity	No major impact
Employment	No major impact
Market structure	No major impact
RACT timing requirements (1982)	Some problem meeting equipment deliveries and installation are anticipated if equipment vendors are overloaded with orders
Problem area	Commercial application of high solids (greater than 62% by volume) has not been proven
VOC emission after RACT control	84 tons/year (30 percent of 1977 emission level)
Cost effectiveness of RACT control	$175 annualized cost/ton VOC reduction

Source: Booz, Allen & Hamilton, Inc.

EXHIBIT 1-10
U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR SOLVENT METAL DEGREASING IN THE STATE OF GEORGIA[1]

Current Situation	Discussion
Number of potentially affected facilities	About 2,300 plants.
Indication of relative importance of industrial section to state economy	Value of shipments of firms in SIC groups affected for nonattainment counties is in the range of 3.6 billion, about 40% of the state total for these SIC groups.
Current industry technology trends	Where technically feasible, firms are substituting exempt solvent.
1977 VOC emissions (actual)	4,800 tons/year. (Including solvents classified as exempt)
Industry preferred method of VOC control to meet RACT guidelines	Substitution. Otherwise lowest cost option as specified by EPA will be used.
Assumed method of VOC control to meet RACT guidelines	Equipment modifications as specified by the RACT guidelines.

Affected Areas in Meeting RACT	Discussion
Capital investment (statewide)	$1.1 million.
Annualized cost (statewide)	$0.14 million, (less than 0.01 percent of the 1977 affected facilities value of shipments).
Price	Metal cleaning is only a fraction of manufacturing costs; price effect expected to be less than 0.01 percent for affected facilities.
Energy	Less than 150 equivalent barrels of oil per year increase.
Productivity	5-10 percent decrease for manually operated degreasers. Will not affect conveyorized cleaners.
Employment	No effect except a possible slight decrease in firms supplying metal degreasing solvents.
Market structure	No change.
RACT timing requirements (1982)	Equipment availability--only a few companies now supply the recommended control modifications.
Problem Areas	No significant problem areas seen. Most firms will be able to absorb cost.
VOC emission after RACT control	3,700 tons/year (11 percent of 1977 VOC emission level--however, this does not include emission controls for exempt solvents.)
Cost effectiveness of RACT control	$127 annualized cost per ton of emissions reduced.

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[1] These estimates were computed for nonattainment counties only. These were Clayton, Columbus, Cobb, Coweta, DeKalb, Douglas, Fayette, Fulton, Gwinett, Henry, Paulding and Rockdale. The proposed regulation would also apply to solvent metal cleaning operations in facilities with potential VOC emissions over 100 tons annually outside the 12 county nonattainment area. Although no facilities outside the nonattainment areas were identified, there may be some affected in the state by the proposed regulations.

Source: Booz, Allen & Hamilton, Inc.

EXHIBIT 1-11
U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR TANK TRUCK GASOLINE LOADING TERMINALS IN GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	33
Indication of relative importance of industrial section to state economy	1977 industry sales were $2.8 billion, with annual throughput of 6.546 billion gallons.
Current industry technology trends	New terminals will be designed with vapor recovery equipment
1977 VOC actual emissions	20,400 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Submerge fill or bottom fill and vapor recovery

Affected Areas in Meeting RACT	Discussion
Capital investment (statewide)	$10.114 million
Annualized credit (statewide)	$0.039 million (approximately 0.001 percent of value of shipment)
Price	Assuming "full cost pass-through," no change in price
Energy	Assuming full recovery of gasoline—net savings of 125,382 barrels annually from terminal emissions
Productivity	No major impact
Employment	No direct impact
Market structure	No direct impact
Problem area	Full gasoline credit from vapors from bulk gasoline plants and gasoline service stations require uniform RACT requirements throughout the state
VOC emission after control	2,000 tons per year
Cost effectiveness of control	$1.71 annualized credit/annual ton of VOC reduction from terminals assuming gasoline credit from vapors returned from bulk gasoline plants and gasoline service stations

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 1-12

U.S. Environmental Protection Agency

SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF
IMPLEMENTING RACT FOR
BULK GASOLINE PLANTS IN GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	35
Indication of relative importance of industrial sector to state economy	1977 affected industry sales were $27 million, with annual throughput of 0.064 billion gallons.
Current industry technology tends	Only small percent of industry has new/ modernized plants
1977 VOC actual emissions	730 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Bottom fill and vapor balancing (cost analysis reflects top submerged fill, not bottom fill)

Affected Areas in Meeting RACT	Discussion
Capital investment (statewide)	$500,000
Annualized cost (statewide)	$130,000 (approximately 0.45 percent of value of shipments from those facilities affected)
Price	Assuming a "direct cost pass-through" . 12 county-wide--$0.0048 per gallon increase . Small operations--$0.005 to $0.01 per gallon increase
Energy	Assuming full recovery of gasoline—net savings of 4,000 barrels annually
Productivity	No major impact
Employment	No direct impact; however for plants closing, potential average of 6 jobs lost per plant closed
Market structure	Regulation could further concentrate a declining industry. Many small bulk gas plants today are marginal operations; further cost increase could result in some plant closings
Problem area	Severe economic impact for small bulk plant operations. Regulation could cause further market imbalances. Technical control feasibility of cost effective alternatives has not been effectively demonstrated
VOC emission after control	150 tons per year
Cost effectiveness	$225 annualized cost/annual ton of VOC reduction

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 1-13
U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR STORAGE OF PETROLEUM LIQUIDS IN THE STATE OF GEORGIA

Current Situation	Discussion
Number of potentially affected Storage tanks	31
Indication of relative importance of industrial section to state economy	The annual throughput was an estimated 455 million gallons
Current industry technology trends	Internal floating roof tanks utilizing a double seal have been proven to be more cost effective
VOC emissions	2,138 tons per year
Preferred method of VOC control to meet RACT guidelines	Single seal and internal floating roof
Affected Areas in Meeting RACT	
Capital investment (statewide)	$2.11 million
Annualized cost (statewide)	$0.3 million
Price	Assuming a "direct cost pass-through— less than 0.1 cents per gallon of throughput
Energy	Assuming 90 percent reduction of current VOC level, the net energy savings represent an estimated savings of 17,000 equivalent barrels of oil annually
Productivity	No major impact
Employment	No major impact
Market Structure	No major impact
Problem area	Potential availability of equipment to implement RACT standard
VOC emission after control	238 tons per year
Cost effectiveness of control	$144 annualized cost/annual ton of VOC reduction

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 1-14

U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR GASOLINE DISPENSING FACILITIES IN THE STATE OF GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	4,325
Indication of relative importance of industrial sector to county economy	12 county industry sales are $529 million with a yearly throughput of 1.04 billion gallons
Current industry technology trends	Number of stations has been declining and throughput per station has been increasing. By 1980, one-half of stations in U.S. are predicted to become totally self-service
1977 VOC emissions (actual)	4,026 tons per year from tank loading operation
Industry preferred method of VOC control to meet RACT guidelines	Submerged fill and vapor balance
Assumed method of control to meet RACT guidelines	Submerged fill and vapor balance
Affected Areas in Meeting RACT	**Discussion**
Capital investment (12 counties)	$2.7 million
Annualized cost (12 counties)	$0.686 million (less than 0.1 percent of the value of gasoline sold)
Price	Assuming a "direct cost pass-through"--less than $0.001 per gallon of gasoline sold in the 12 counties
Energy	Assuming full recovery: 1,234,000 gallons/year (24,919 equivalent barrels of oil) saved[a]
Productivity	No major impact
Employment	No major impact
Market structure	Compliance requirements may accelerate the industry trend towards high throughput stations (i.e., marginal operations may opt to shut down)

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[a] One gallon of gasoline has 125,000 BTU's. One barrel of oil equivalent has 6,050,000 BTU's.

EXHIBIT 1-14(2)
U.S. Environmental Protection Agency

RACT timing requirements (1982)	Retrofitting all service stations within time constraints may be difficult in a few instances
Problem area	Older stations face higher retrofit costs--potential concerns are dislocations during installations
VOC emission after RACT control	201 tons per year from tank loading operation
Cost effectiveness of RACT control	$170 annualized cost/annual ton of VOC reduction

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 1-15
U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR USE OF CUTBACK ASPHALT IN THE STATE OF GEORGIA

Current Situation	Discussion
Use potentially affected	In 1977, use of cutback asphalt was 34,190 tons statewide and an estimated 12,821 tons in non-attainment counties.
Indication of relative importance of industrial section to non-attainment county economies	1977 sales of cutback asphalt were estimated to be $3.2 million statewide and $1.2 million in non-attainment counties.
Current industry technology trends	Nationally, use of cutback asphalt has been declining.
1977 VOC emissions (actual)	7,070 tons annually statewide; 2,660 in non-attainment counties, 1,460 of which are non-exempted
Industry preferred method of VOC control to meet RACT guidelines	Replace with asphalt emulsions
Assumed method of control to meet RACT guidelines	Replace with asphalt emulsions

Affected Areas in Meeting RACT	Discussion
Capital investment in non-attainment areas	$0.06 million
Annualized cost in non-attainment areas	No changes in paving costs are expected.
Price	No changes in paving costs are expected.
Energy	14,100 equivalent barrels of oil saved[a]
Productivity	No major impact
Employment	No major impact

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[a] The saving accrues to manufacturer, not user. The total energy associated with manufacturing, processing and laying one gallon of cutback is approximately 50,200 BTUs/gallon. For emulsified asphalts, it is 2,830 BTUs/gallon. One barrel of oil equivalent is assumed to have 6.05 million BTUs, and one ton of cutback asphalt is assumed to have 256 gallons.

2.0 INTRODUCTION AND OVERALL STUDY APPROACH

This chapter presents an overview of the study's purpose, scope and methodology. It is divided into six sections:

- Background
- Summary of State Implementation Plan revisions and state's need for assistance
- Scope
- Approach
- Quality of estimates
- Definition of terms used.

Each of these sections is discussed below.

The approach and quality of estimates is discussed in detail in each of the respective chapters dealing with the specific industrial categories affected by the volatile organic compounds control regulations.

2.1 BACKGROUND

The Clean Air Act Amendments of 1977 required the states to revise their State Implementation Plans (SIPs) to provide for the attainment and maintenance of national ambient air quality standards in areas designated as nonattainment. The Amendments require that each state submit the SIP revisions to the U.S. Environmental Protection Agency (EPA) by January 1, 1979. These proposed regulations should contain an oxidant plan submission for major urban areas to reflect the application of Reasonably Available Control Technology (RACT) to stationary sources for which the EPA has published guidelines. The Amendments also require that the states identify and analyze the air quality, health, welfare, economic, energy and social effects of the plan provisions.

Under the direction of Region IV, the EPA contracted with Booz, Allen & Hamilton Inc. (Booz, Allen) to assist the states of Alabama, Georgia, Kentucky, North Carolina, South Carolina and Tennessee in analyzing the economic, energy and social impacts of the SIP revisions proposed by these states. The assignment was initiated on September 28, 1978, and, as a first step, the proposed SIP revisions and the type of assistance desired by each state were reviewed.

After a review with each of the states and EPA Region IV representatives, a work scope was defined that would include in the study an analysis of the direct economic and energy impacts for those industrial segments most likely to have a significant impact at the statewide level. For the most part this included industrial categories that had more than a few facilities potentially affected. The next section discusses those specific industrial categories included in this work scope.

2.2 SUMMARY OF PROPOSED SIP REVISIONS IN GEORGIA AND THE STATE'S NEED FOR CONTRACTOR SUPPORT

Georgia has proposed statewide regulations to reduce volatile organic compound (VOC) emissions by implementing the Reasonably Available Control Technology (RACT) guidelines developed by the EPA for existing stationary sources. The state is also studying implementation of motor vehicle inspection/maintenance programs in the non-attainment areas. In addition, the state has proposed an opacity standard for total suspended particulates (TSP) emissions.

The state officials were interviewed to determine their need for support in analyzing the economic impact of the SIP revisions. The analysis of implementing the RACT guidelines for reducing VOC emissions was expressed as the fundamental concern. Specifically, the state needed assistance in the analysis of 12 of the 15 industrial categories for which the EPA has published RACT guidelines. These 12 RACT industrial categories are described in the next section. The other three industrial categories (surface coating of coil and magnet wire insulation and miscellaneous refinery sources) were excluded from this study because a very limited number of sources were affected by the proposed regulations in those categories. Although the cost impact in those categories excluded might be significant for an individual firm studied, it is unlikely that the economic or energy impact at the macrolevel (statewide) would be significant.

2.3 SCOPE

The primary objective of this study is to determine the costs and impact of compliance with the proposed SIP revisions for six states in EPA, Region IV. The study will emphasize the analysis of direct economic costs and benefits of the proposed SIP revisions. Secondary (social and energy) impacts will also be addressed but are not the major study emphasis.

In Georgia, the economic impact will be analyzed for the implementation of RACT guidelines to reduce VOC from the following 12 industry categories:

- Surface coating of metal cans
- Surface coating of paper
- Surface coating of fabrics
- Surface coating of automobiles and light duty trucks
- Surface coating of metal furniture
- Surface coating of large appliances
- Solvent metal cleaning
- Bulk gasoline terminals
- Bulk gasoline plants
- Storage of petroleum liquids in fixed roof tanks
- Service stations—Stage I
- Use of cutback asphalt.

The major study guidelines in the determination of the economic impact of the RACT guidelines are discussed below.

- The emission limitations for each industrial category will be studied at the control level established by the RACT guidelines. These are presented in Exhibit 2-1, on the following page.
- All costs and emission data were presented for 1977.
- Emissions sources included were existing stationary point sources in the applicable industrial categories with VOC emissions greater than 5 pounds in any hour or 50 pounds in any day in 12 counties that were classified as non-attainment for ozone.[1] In the rest of the state, only sources with greater than 100 tons/year of potential VOC emissions will be included in the study.

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[1] The non-attainment counties include: Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Fulton, Gwinnett, Henry, Paulding, Rockdale, and Muscogee (Columbus).

EXHIBIT 2-1(1)

U.S. Environmental Protection Agency
LISTING OF EMISSION LIMITATIONS THAT REPRESENT
THE PRESUMPTIVE NORM TO BE ACHIEVED THROUGH
APPLICATION OF RACT FOR FIFTEEN INDUSTRY CATEGORIES

Category	RACT Guideline Emission Limitations[a] Surface Coating Categories Based on Low Organic Solvent Coatings (lbs. solvent per gallon of coating, minus water)
Surface Coating Of:	
Cans	
. Sheet basecoat (exterior and interior) Overvarnish Two-piece can exterior (basecoat and overvarnish)	2.8
. Two and three-piece can interior body spray Two-piece can exterior end (spray or rollcoat)	4.2
. Three-piece can side-seam spray	5.5
. End sealing compound	3.7
Coils	
. Prime and topcoat or single coat	2.6
Paper	2.9
Fabrics and vinyl coating	
. Fabric	2.9
. Vinyl	3.8
Automobiles and Light Duty Trucks	
. Prime application, flashoff and oven	1.9
. Topcoat application, flashoff and oven	2.8
. Final repair application, flashoff and oven	4.8
Metal Furniture	
. Prime and topcoat or single coat	3.0
Magnet Wire	1.7
Large appliance	
. Prime, single or topcoat	2.8
Solvent Metal Cleaning	
. Cold cleaning	Provide cleaners with: cover; facility to drain clean parts; additional freeboard; chiller or carbon absorber. Follow suggested procedures to minimize carryout.
. Conveyorized degreaser	Provide cleaners with: refrigerated chillers; or carbon adsorption system; drying tunnel or rotating basket; safety switches; covers. Follow suggested procedures to minimize carryout.
. Open top degreaser	Provide cleaner with: safety switches; powered cover; chiller; carbon absorber. Follow suggested procedures to minimize carryout.
Petroleum Refinery Sources	
. Vacuum producing systems	No emissions of any noncondensible VOC from condensers, hot wells or accumulators to a firebox, incinerator or boiler.

EXHIBIT 2-1(2)
U.S. Environmental Protection Agency

Category	RACT Guidelines Emission Limitations[a]
. Wastewater separators	Minimize emissions of VOC by providing covers and seals on all separators and forebays and following suggested operating procedures to minimize emissions
. Process unit turnaround	Minimize emissions of VOC by depressurizatio venting to vapor recovery, flare or firebox. No emissions of VOC from a process unit or vessel until its internal pressure is 136 kilo Pascals (17.7 psia) or less
Bulk Gasoline Terminals	Equipment such as vapor control system to prevent mass emissions of VOC from control equipment to exceed 80 milligrams per liter (4.7 grains per gallon) of gasoline loaded
Bulk Gasoline Plants	Provide submerged filling and vapor balancing or equivalent control to reduce VOC emissions. Follow suggested procedures to minimize vapor losses.
Storage of Petroleum Liquids in Fixed Roof Tanks	Provide single seal and internal floating roof to all fixed roof storage vessels with capacities greater than 150,000 liters (39,000 gal.) containing volatile petroleum liquids for which true vapor pressure is greater than 10.5 kilo Pascals (1.52 psia)
Service Stations (Stage I)	Provide submerged fill and vapor balance for any stationary storage tank located at a gasoline dispensing facility with a capacity of 7,500 liters (2,000 gal.) or greater which is in place before January 1, 1979, or any stationary storage tank located at a gasoline dispensing facility with a capacity of 948 liters (250 gal.) or more which is in place before January 1, 1978. Follow suggested procedure to minimize vapor losses.
Use of Cutback Asphalt	The manufacture, mixing, storage, use or application may be approved where: long-life stockpile storage is necessary; the use or application is an ambient temperature less than 10°C (50°F) is necessary; or it is to be used solely as a penetrating prime coat

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Note: An alternative scenario to the recommended RACT guidelines for surface coating of automobiles is also studied. It assumes that the timing requirements and possible limitations are modified to meet developing technologies.

a. Annotated description of RACT guidelines

Source: Regulatory Guidance for Control of Volatile Organic Compound Emissions from 15 Categories of Stationary Sources, U.S. Environmental Protection Agency, EPA-90512-78-001, April 1978.

- Service stations, bulk plants, solvent metal cleaning, and the use of cutback asphalt were studied for the 12 non-attainment counties only.
- The following volatile organic compounds were exempted:
  - Methane
  - Ethane
  - Trichlorotrifluorethane (Freon 113)
  - 1,1,1-trichloroethane (methyl chloroform).[1]
- The timing requirement for implementation of controls to meet RACT emission limitations was January 1, 1981 for cutback asphalt and July 1, 1982 for the other industry categories.

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[1] The exemption status of methyl chloroform under these guidelines may be subject to change.

2.4 APPROACH

This section describes the overall approach and methodology applied in this assignment. In general, the approach varied for each state and also for each industrial category studied. This section specifically describes the overall approach that was applied for the State of Georgia. The methodology applied to determine the economic impact for each industrial category in Georgia is described in further detail in the first section of each chapter dealing with the specific industry category.

There are five parts to this section to describe the approach for determining estimates of:

- Industry statistics
- VOC emissions
- Process descriptions
- Cost of controlling VOC emissions
- Comparison of direct costs with selected direct economic indicators.

2.4.1 Industry Statistics

The assembly of economic and statistical data for each industrial category was an important element in establishing the data base that was used for projection and evaluation of the emissions impact. Some of the major variables for each industrial category were:

- Number of manufacturers
- Number of employees
- Value of shipments
- Number of units manufactured
- Capital expenditures
- Energy consumption
- Productivity indices

- Current economics (financial) status
- Industry concentration
- Business patterns (small vs. large; downstream integration)
- Age distribution of facilities
- Future trends and developments.

Some of the industrial categories studied cover a large number of potentially affected facilities. For these categories, industry statistical data were collected by applying a categorical approach rather than by attempting to identify all the individual firms likely to be affected. The industrial categories studied by this approach included:

- Solvent metal cleaning
- Gasoline service stations
- Use of cutback asphalt.

For these industrial categories, secondary data sources and nonconfidential Booz, Allen files served as the primary resources for the data base. Industry and association interviews were then conducted to complete, refine and validate the industry statistical data base.

For the remaining industrial categories studied, a more deliberate approach was applied:

- For the surface coating categories, the facilities potentially affected by the RACT guidelines were identified from secondary data sources. The state officials then performed telephone interviews to determine whether these facilities perform surface coating operations or not. The Booz, Allen study team then performed further telephone interviews with the potentially affected facilities identified by the state to verify their inclusion.

- For bulk gasoline plants and terminals and fixed-roof tanks, the list of potentially affected facilities was compiled by the Georgia Department of Natural Resources

- Industry category statistical data were compiled using secondary sources such as:

    - Department of Commerce
    - Census of Manufacturers
    - Trade associations
    - Bureau of Labor Statistics
    - National Technical Information Services.

- The industry statistical data were refined by two mechanisms:

    - Assessing the statistical data for reasonableness in comparison to the list of potentially affected facilities

    - Using industry and association interviews for completion and validation.

2.4.2 VOC Emissions

Since no emissions data were available from the state emissions inventory, emissions were estimated by the Booz, Allen study team using different approaches depending upon the availability of data on characteristics of affected facilities.

- For bulk gasoline plants and terminals and fixed-roof tanks, emissions were estimated by using facility characteristics data provided by the state and emission factors developed by U.S. EPA.

- For the surface coating industry categories, emissions were estimated by using data provided by the industry to Booz, Allen during telephone interviews.

- For the other categories to be studied, the emissions were estimated by applying relevant factors (VOC emissions per facility, throughput, etc.) that had been developed by EPA studies. Although this categorical approach cannot be validated to the degree of a point source by point source approach, the emissions can be reasonably estimated on a statewide basis because of the large number of sources in each RACT industrial category. Emissions were estimated by this approach for the following RACT industrial categories:

    - Solvent metal cleaning
    - Service stations
    - Cutback asphalt.

The emission estimates for each of the 12 RACT industrial categories studied were refined during industry interviews.

2.4.3 Process Descriptions

For each of the industrial categories, the basic technology and emission data were reviewed and summarized concisely for subsequent evaluation of engineering alternatives. In this task, the RACT documents that had been prepared for each industrial category and other air pollution control engineering studies served as the basis for defining technological practice. Additional alternatives of control that met the requirements of the RACT guidelines were identified from literature search. The most likely control alternatives were assessed and evaluated by:

- Technical staff at Booz, Allen
- Interviews with industry representatives
- Interviews with EPA representatives
- Interviews with equipment manufacturers.

2.4.4 Cost of Controlling VOC Emissions

The cost of control to meet the requirements of the RACT guidelines had been presented in the RACT documents, other technical EPA studies and trade journal technical documents and by industry representatives. The approach applied in developing capital and annualized cost estimates was to:

- Utilize available secondary source information as the primary data source

- Validate the control alternatives industry is likely to apply

- Calibrate these cost estimates provided in technical documents.

It was not within the purpose or the scope of this project to provide detailed engineering costs to estimate the cost of compliance.

Cost data presented within the body of the report were standardized in the following manner:

- All cost figures are presented for a base year, 1977.

- Capital cost figures represent installed equipment cost including:

  - Engineering
  - Design
  - Materials
  - Equipment
  - Construction.

  The capital cost estimates do not account for costs such as:

  - Clean-up of equipment
  - Lost sales during equipment downtime
  - Equipment start-up and testing
  - Initial provisions (spare parts).

- Capital related annual costs are estimated at 24 percent of the total capital cost per year (unless explicitly stated otherwise). The estimation procedure applied was built up from the following factors:

  - Depreciation—10 percent (assuming straight-line over a ten-year life)

  - Interest—10 percent

  - Taxes and insurance—4 percent.

  The capital-related annual costs do not account for investment costs in terms of return or investment parameters (i.e., the "opportunity cost" of money is not included).

- Annual operating costs of compliance with the RACT guidelines were estimated for each of the control alternatives studied. The annual operating costs included were:

  - Direct labor
  - Raw material costs (or savings)
  - Energy
  - Product recovery cost (or savings)
  - Maintenance.

Other types of costs, not included in this analysis, involve compliance costs, such as:

- Demonstration of control equipment efficiency
- Supervisory or management time
- Cost of labor or downtime during installation and startup.

- The annualized cost is the total of direct operating costs (including product or raw material recovery) and the capital related annual costs.

2.4.5 Comparison of Direct Cost with Selected Direct Economic Indicators

In each of the industrial categories studied, after the costs (or savings) of compliance had been determined, these costs were compared with selected economic indicators. This comparison was performed to gain a perspective on the compliance costs rather than to estimate price changes or other secondary effects of the regulation. Presented below are typical comparisons of direct costs with indicators that are presented in this study.

- Annualized cost in relation to current price—To gain a perspective on the compliance cost in relation to current prices of the manufactured items at the potentially affected facilities, the annualized cost is presented in terms of a price increase assuming a direct pass-through of costs to the marketplace.
  - This analysis was based on the average cost change (including those facilities that may have little or no economic impact associated with meeting the proposed standards) divided by the average unit price of goods manufactured.
  - For this reason as well as many others (that might be addressed in a rigorous input-output study to estimate eventual price increase), this analysis should not be interpreted as forecast of price changes due to the proposed standards.

- Annualized costs as a percent of current value of shipment—The annualized costs applied are for all those facilities potentially affected divided by the estimated value of shipments for the statewide industrial category (i.e., including those facilities which currently may meet the proposed standard). This approach tends to understate the effect to those specific firms requiring additional expenses to meet the proposed standard. Therefore, when available, the compliance cost is also presented as a percent of the value of shipments for only those firms not currently meeting the proposed regulation.

- Capital investment as a percent of current annual capital appropriations—Estimated statewide capital investment for the potentially affected facilities divided by the estimated capital appropriations for the industry affected as a whole in the state (including those facilities that may not require any capital investment to meet the proposed standard).

2.5 QUALITY OF ESTIMATES

The quality of the estimates that are presented in this report can be judged by evaluating the basis for estimates of the individual study components. In each of the chapters that deal with the development of estimated compliance cost, the sources of information are fully documented. In addition, the study team has categorically ranked the overall data quality of the major sources and, therefore, of the outcomes. These data quality estimates were ranked into three categories:

- High quality ("hard data")—study inputs with variation of not more than ± 25 percent
- Medium quality ("extrapolated data")—study inputs with variation of ± 25 to 75 percent
- Low quality ("rough data")—study inputs with variation of ± 50 to 150 percent.

Each of these data quality estimates is presented in the individual chapters. The overall quality ranking of the study inputs for each RACT industrial category was generally in the medium quality range.

2.6 DEFINITIONS OF TERMS

Listed below are definitions of terms that are used in the body of the report:

- Capture system--the equipment (including hoods, ducts, fans, etc.) used to contain, capture, or transport a pollutant to a control device.
- Coating applicator--an apparatus used to apply a surface coating.
- Coating line--one or more apparatuses or operations which include a coating applicator, flash-off area and oven, wherein a surface coating is applied, dried and/or cured.
- Control device--equipment (incinerator, adsorber or the like) used to destroy or remove air pollutant(s) prior to discharge to the ambient air.
- Continuous vapor control system--a vapor control system that treats vapors displaced from tanks during filling on a demand basis without intermediate accumulation.
- Direct cost pass-through--the relationship of the direct annualized compliance cost (increase or decrease) to meet the RACT limitations in terms of units produced (costs per unit value of manufactured goods.)
- Emission--the release or discharge, whether directly or indirectly, of any air pollutant into the ambient air from any source.
- Facility--any building, structure, installation, activity or combination thereof which contains a stationary source of air contaminants.
- Flashoff area--the space between the application area and the oven.
- Hydrocarbon--any organic compound of carbon and hydrogen only.

- Incinerator--a combustion apparatus designed for high temperature operation in which solid, semisolid, liquid or gaseous combustible wastes are ignited and burned efficiently and from which the solid and gaseous residues contain little or no combustible material.
- Intermittent vapor control system--a vapor control system that employs an intermediate vapor holder to accumulate vapors displaced from tanks during filling. The control device treats the accumulated vapors only during automatically controlled cycles.
- Loading rack--an aggregation or combination of gasoline loading equipment arranged so that all loading outlets in the combination can be connected to a tank truck or trailer parked in a specified loading space.
- Organic material--a chemical compound of carbon excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate.
- Oven--a chamber within which heat is used to bake, cure, polymerize and/or dry a surface coating.
- Prime coat--the first film of coating applied in a two-coat operation.
- Reasonably available control technology (RACT)--the lowest emission limit as defined by EPA that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility. It may require technology that has been applied to similar, but not necessarily identical, source categories.
- Reid vapor pressure--the absolute vapor pressure of volatile crude oil and volatile nonviscous petroleum liquids, except liquified petroleum gases, as determined by American Society for Testing and Materials, Part 17, 1973, D-323-72 (Reapproved 1977).
- Shutdown--the cessation of operation of a facility or emission control equipment.

- Solvent--organic material which is liquid at standard conditions and which is used as a dissolver, viscosity reducer or cleaning agent.
- Standard conditions--a temperature of 20°C (68°F) and pressure of 760 millimeters of mercury (29.92 inches of mercury).
- Startup--the setting in operation of a source or emission control equipment.
- Stationary source--any article, machine, process equipment or other contrivance from which air pollutants emanate or are emitted, either directly or indirectly, from a fixed location.
- Topcoat--the final film of coating applied in a multiple coat operation.
- True vapor pressure--the equilibrium partial pressure exerted by a petroleum liquid as determined in accordance with methods described in American Petroleum Institute Bulletin 2517, "Evaporation Loss from Floating Roof Tanks," 1962.
- Equivalent barrel of oil--energy demand is converted into barrels of oil at the conversion rate of 6,000,000 BTU per barrel of oil.
- Vapor collection system--a vapor transport system which uses direct displacement by the liquid loaded to force vapors from the tank into a vapor control system.
- Vapor control system--a system that prevents release to the atmosphere of at least 90 percent by weight of organic compounds in the vapors displaced from a tank during the transfer of gasoline.
- Volatile organic compound (VOC)--any compound of carbon that has a vapor pressure greater than 0.1 millimeters of mercury at standard conditions excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates and ammonium carbonate.

3.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT FOR CAN MANUFACTURING PLANTS IN THE STATE OF GEORGIA

This chapter presents a detailed economic analysis of implementing RACT controls for can manufacturing plants in the State of Georgia. The chapter is divided into five sections:

- Specific methodology and quality of estimates

- Industry statistics

- The technical situation in the industry

- Cost and VOC reduction benefit evaluations for the most likely RACT alternatives

- Direct economic implications and selected secondary impacts.

Each section presents detailed data and findings based on analyses of the RACT guidelines, previous studies of can manufacturing plants, interviews and analysis.

3.1 SPECIFIC METHODOLOGY AND QUALITY OF ESTIMATES

This section describes the methodology for determining estimates of:

- Industry statistics
- VOC emissions
- Processes for controlling VOC emissions
- Cost of controlling VOC emissions
- Economic impact of emission control

for can manufacturing plants in Georgia.

The quality of the estimates is described in detail in the latter part of this section.

3.1.1 Industry Statistics

Industry statistics on can manufacturing plants in Georgia were unavailable from the standard sources. No data for Georgia were given in Current Industrial Reports, Metal Cans, Summary for 1976. Most industry statistics for Georgia were withheld in the 1972 Census of Manufactures, though one table (6B) reported value of shipments of $76.7 million. Interviews in the state revealed, however, that extrapolations based on this figure were unrealistically low, so this number was not utilized in the report.

Emissions data provided the best source of current data on can manufacturing in Georgia. Emissions data were correlated with emissions factors developed for typical plants, and the number of cans manufactured in Georgia was developed from these data. The exact calculations are shown in Exhibit 3-16.

Georgia value of shipments estimates were developed by relating the Georgia production figures to U.S. statistics for can production, and applying a ratio of value of shipments to can production from U.S. statistics.

The basis for this analysis is the 1976 U.S. statistics for the can industry as presented in Current Industrial Reports. These statistics are excerpted below, along with 1977 projections which were based on the estimates in U.S. Industrial Outlook, 1977, that production of cans in 1977 increased by 3 percent, and value of shipments by 10 percent.

Industry Statistics	1976 U.S. Data	1977 Projections
Number of cans (millions)	83,972	86,500
Quantity (1,000 base boxes of metal)[a]	180,141	185,500
Value of shipments ($ million)	6,357.5	6,990
Ratio of value of shipments to number of cans ($/million cans)	75,700	80,800

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[a] A base box is an area of 31,360 square inches, equivalent to 112 sheets, 14 inches X 20 inches in size.

The 1977 ratio of value of shipments to number of cans was used to estimate the value of shipments in the State of Georgia.

Employment figures in the can industry were obtained from County Business Patterns, 1976. Capital investment was roughly estimated by prorating the statistics presented in Current Industrial Reports for the U.S. to the proportion of the industry in Georgia and adjusted to 1977 by applying the proportion of the value of shipments for the U.S. industry in 1977 ($6.99 billion) to that of 1972 ($4.5 billion).

3.1.2 VOC Emissions

The data for determining the current level of emissions from six plants were provided by the State of Georgia, Department of Natural Resources, from its permit files, supplemented by direct input from the firms involved, where no data were available from the state.

3.1.3 Processes for Controlling VOC Emissions

Processes for controlling VOC emissions for can manufacturing plants are described in Control of Volatile Organic Emissions from Stationary Sources, EPA-450/2-77-008. These data provide the alternatives available for controlling VOC emissions from can manufacturing plants. Several studies of VOC emission control were analyzed in detail, and the industry trade association and can manufacturers were interviewed to ascertain the most likely types of control techniques to be used in can manufacturing plants. The specific studies analyzed were Air Pollution Control Engineering and Cost Study of General Surface Coating Industry, Second Interim Report, Springborn Laboratories, and informational literature supplied by the Can Manufacturers Institute to the state EPA programs.

The alternative approaches to VOC control as presented in the RACT document were supplemented by several other approaches. The approaches were arrayed and the emissions to be reduced from using each type of control were determined. This scheme forms the basis of the cost analysis, for which the methodology is described in the following paragraphs.

3.1.4 Cost of Control Approaches and the Resulting Reduction in VOCs

The costs of VOC control approaches were developed by:

- Separating the manufacturing process into discrete coating operations on a national basis:
  - By can manufacturing technology
  - By type of can manufactured; i.e., beverage vs. food

- Determining the alternative approaches to control likely to be used for each type of coating operation and the cost factors involved

- Estimating installed capital costs for each approach

- Estimating the probable use of each approach to control considering:

  - Installed capital cost
  - Annualized operating cost
  - Incremental costs for materials and energy
  - Technical feasibility by 1981

- Aggregating costs to the total industry in Georgia.

Costs were determined from analysis of the previously mentioned studies:

- Control of Volatile Organic Emissions from Stationary Sources, EPA-450/2-77-008

- Air Pollution Control Engineering and Cost Study of General Surface Coating Industry, Second Interim Report, Springborn Laboratories.

and from informational data supplied by the Can Manufacturers Institute and from interviews with major can manufacturing companies.

The cost of compliance and the expected emission reduction in Georgia were developed based on can industry operational data and refined using interviews with can manufacturers. Based upon the assessment of the degree and types of controls currently in place, the cost of VOC emission control and the net reduction in emissions were estimated.

3.1.5 Economic Impact

The economic impact was analyzed by considering the lead time requirements needed to implement RACT, assessing the feasibility of instituting RACT controls in terms of available technology, comparing the direct costs of RACT control to various state economic indicators and assessing the secondary impacts on market structure, employment and productivity from implementing RACT controls in Georgia.

3.1.6 Quality of Estimates

Several sources of information were utilized in assessing the emissions, cost and economic impact of implementing RACT controls on can manufacturing plants in Georgia. A rating scheme is presented in this section to indicate the quality of the data available for use in this study. A rating of "A" indicates hard data, "B" indicates data were extrapolated from hard data and "C" indicates data were estimated based on interviews, analyses of previous studies and best engineering judgment. Exhibit 3-1, on the following page, rates each study output and overall quality of the data.

EXHIBIT 3-1
U.S. Environmental Protection Agency
DATA QUALITY

Study Outputs	A "Hard Data"	B "Extrapolated Data"	C "Estimated Data"
Industry statistics		X	
Emissions	X	X	
Cost of emissions control			X
Statewide costs of emissions control			X
Overall quality of data		X	

Source: Booz, Allen & Hamilton Inc.

3.2 INDUSTRY STATISTICS

Industry characteristics, statistics and business trends for can manufacturing plants in Georgia are presented in this section. Data in this section form the basis for assessing the impact of implementing RACT to VOC emissions for can manufacturing plants in the state.

3.2.1 Size of the Industry

Six can manufacturing facilities in Georgia, representing three companies, have been identified as potentially affected by the proposed regulations. Four of these are located in nonattainment areas. The other two, located in unclassified areas, are included because their VOC emissions are above 100 tons per year, the level above which the proposed regulations are to apply.

There are three modes of operation in the state:

- Assembly of cans from precoated stock--three plants
- Sheet coating and assembly--two plants
- Manufacture of two-piece cans from uncoated coiled metal stock--one plant.

Exhibit 3-2, on the following page, presents a list of the six can facilities in the state that have been identified.

The can industry in Georgia manufactured an estimated 3.6 billion cans, with an estimated value of $290 million in 1977. Employment is estimated at about 1,600. Can industry capital expenditures are estimated to have been $10 million in the state of Georgia in 1977, based on extrapolation of 1972 data. Because of the protection methodology, the capital expenditure figure might be grossly different in any single year.

3.2.2 Comparison of the Industry to the State Economy

The Georgia can manufacturing industry employs 0.1 percent of the state labor force, excluding government employees.

EXHIBIT 3-2
U.S. Environmental Protection Agency
LIST OF METAL CAN MANUFACTURING FACILITIES POTENTIALLY AFFECTED BY RACT IN GEORGIA

Name of Firm	Location	Product	Notes
American Can Company	College Park	3-piece beverage cans	Assembly only
American Can Company	Forest Park	3-piece beverage and food cans	Sheet coating and assembly
American Can Company	Columbus	3-piece beverage cans	Assembly only
Continental Can Group	Forest Park	3-piece beverage cans	Assembly only
Continental Can Group	Perry	2-piece beverage cans	Assembly only
Standard Container Company	Homerville	3-piece paint cans, cone type cans, gasoline cans	Sheet coating and assembly

Source: State of Georgia Department of Natural Resources, and Booz, Allen & Hamilton Inc. interviews

3.2.3 Characterization of the Industry

The can industry is composed of independent and captive manufacturers. Nationwide, about 70 percent of all cans are produced by independent manufacturers and about 30 percent by captive producers. The majority of captive can producers use the cans to package canned food/soup and beer. In Georgia, the independent producers are the only can manufacturers, though many of the plants are located at the site of major beverage bottlers.

The independent can producers generally operate on a "job shop" basis, producing cans for several customers on the same production facilities. In addition to differences in can size and shape, there are differences in coatings resulting from:

- The need to protect different products with varying characteristics from deterioration through contact with the metal can

- The decoration requirements of customers and requirements for protection of the decoration.

Nationally, the can industry produces more than 600 different shapes, styles and sizes to package more than 2,500 products. A relatively few can sizes and coating combinations employed for packaging beverages and food represent about 80 percent of the market. The approximate percentage of total can production represented by the major groups follows.

Type of Can	Percent of Total Production
Beer and soft drink	54
Fruit and vegetable	18
Food cans in the category that includes soup cans	8
Other	20
TOTAL	100

In Georgia, the small can industry is focused on meeting the needs of the beverage, food and specialty products canning industries. Of the 3.6 billion cans produced in Georgia in 1977, approximately 2.8 billion (77 percent) are estimated to have been beer and soft drink cans, and 0.8 billion (23 percent) were food or other product cans. The distribution and the method used for estimating are presented later, in Exhibit 3-16.

Nationally, the can industry has experienced rapid technological changes since 1970 caused by the introduction of new can making technology--the two-piece can. These changes in can manufacturing technology have resulted in the closing of many can plants producing the traditional three-piece product and replacing the capacity with two-piece cans. There is evidence that this trend will continue, so that by 1981 about 80 percent of the beverage cans and a relatively small but growing percentage of other cans will be of two-piece construction. In Georgia, the two-piece can lines that exist have replaced 3-piece lines.

3.3 THE TECHNICAL SITUATION IN THE INDUSTRY

This section presents information on can manufacturing operation, estimated VOC emissions, the extent of current vapor control and the likely alternatives which may be used for controlling VOC emissions in Georgia.

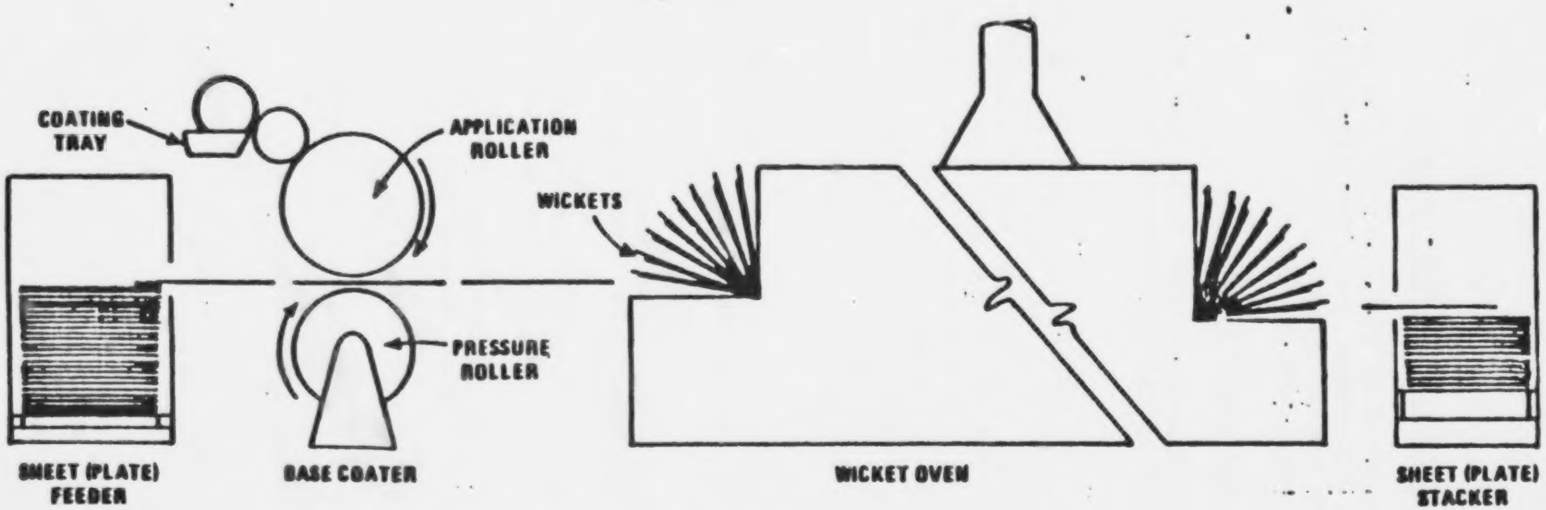
3.3.1 Can Manufacturing Operations

The can industry produces cans using two fundamental technologies, the traditional three-piece method and the newer two-piece technology.

The three-piece can technology consists of two separate operations: sheet coating and can fabrication (assembly). Sheet coating and can assembly operations are frequently performed in separate facilities. The major can manufacturers operate centralized facilities for the coating and decorating of flat sheets. These centralized plants are often called "feeder plants." Sheets are coated at a rate of about 2.5 base boxes per minute, which is equivalent to approximately 2,250 twelve-ounce cans per minute. The specific operations in three-piece can manufacture are summarized below.

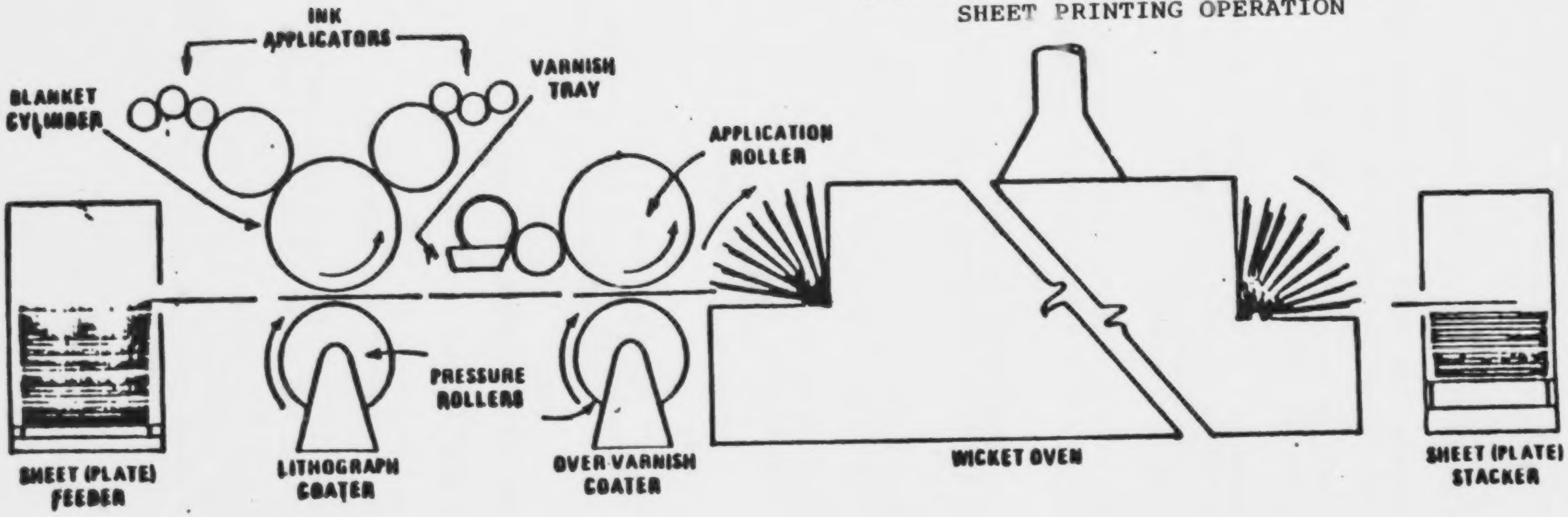
- Sheets of metal are coated and decorated with 28 or 35 can bodies (outs). This is accomplished in two steps.
    - The sheets are base coated on the interior side and then passed through a wicket oven.
    - Food cans, as well as some beer and soft drink cans, are given an exterior base coat.
    - In the case of beer and soft drink cans, the base coated sheets are decorated (printed), over coated with varnish and then cured in a smaller wicket oven.
    - Exhibits 3-3 and 3-4, on the following pages, present flow diagrams of the base coating and decorating operations.

EXHIBIT 3-3
U.S. Environmental Protection Agency
SHEET BASE COATING OPERATION


COATING TRAY
APPLICATION ROLLER
WICKETS
PRESSURE ROLLER
SHEET (PLATE) FEEDER
BASE COATER
WICKET OVEN
SHEET (PLATE) STACKER

Source: U.S. Environmental Protection Agency

EXHIBIT 3-4
U.S. Environmental Protection Agency
SHEET PRINTING OPERATION


INK APPLICATORS
BLANKET CYLINDER
VARNISH TRAY
APPLICATION ROLLER
PRESSURE ROLLERS
SHEET (PLATE) FEEDER
LITHOGRAPH COATER
OVER VARNISH COATER
WICKET OVEN
SHEET (PLATE) STACKER

Source: U.S. Environmental Protection Agency

- Can bodies are formed from the coated sheets.
    - The printed sheets are slit into individual body blanks and fed into the "body maker."
    - The blank is rolled into a cylinder and soldered, welded or cemented.
    - The seam is sprayed (striped) on the inside and outside with an air dry lacquer to protect the exposed metal. Sometimes this is done only on the inside surfaces.
- Can ends are formed from coated sheet stock and fed to the end seamer where final fabrication is completed.
    - Can ends are stamped from coated stock and perimeter coated with synthetic rubber compound gasketing.
    - Solvent-based compounds are air-dried and water-based compounds are oven-dried.
- The can is fabricated from the body and the end in an "end sealer," leak tested and palletized for shipment. Exhibit 3-5, on the following page, presents a schematic diagram of can end and three-piece can fabricating operations.

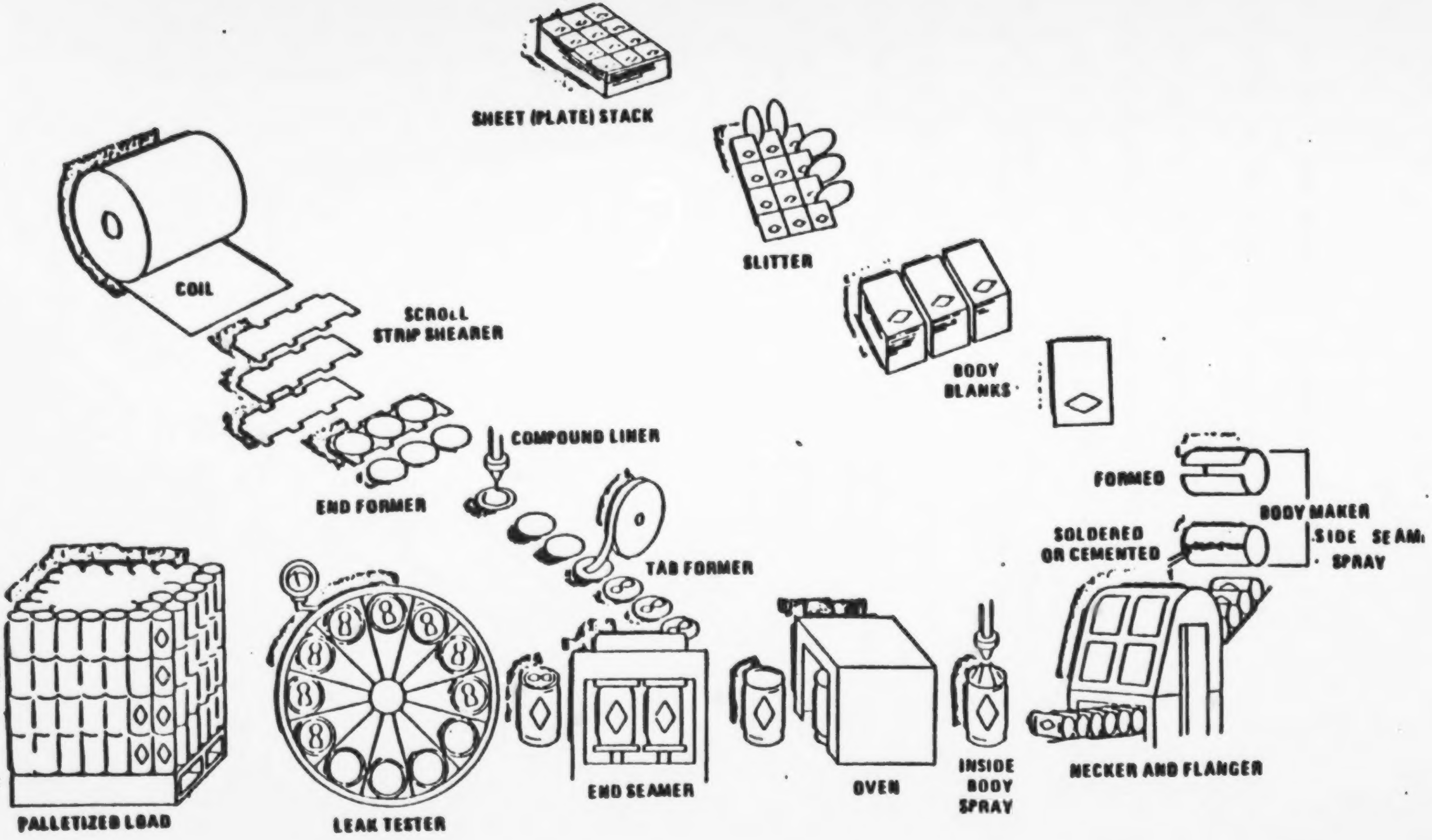
Two-piece cans are generally manufactured in an integrated high-speed process capable of producing 600 or 800 cans per minute. (There was one two-piece plant operating in Georgia during 1977.)

- Coil stock is formed into a shallow cup.
- The cups are drawn and ironed into the form of a can.
- The cans are washed to remove the lubricant.
- An exterior base coat is applied (if required) by reverse roller coating and cured in a continuous oven.
- The cans are printed and then coated with a protective varnish. The coating is then baked in an oven. Steel cans are sometimes given two separate interior coatings.

EXHIBIT 3-5

U.S. Environmental Protection Agency

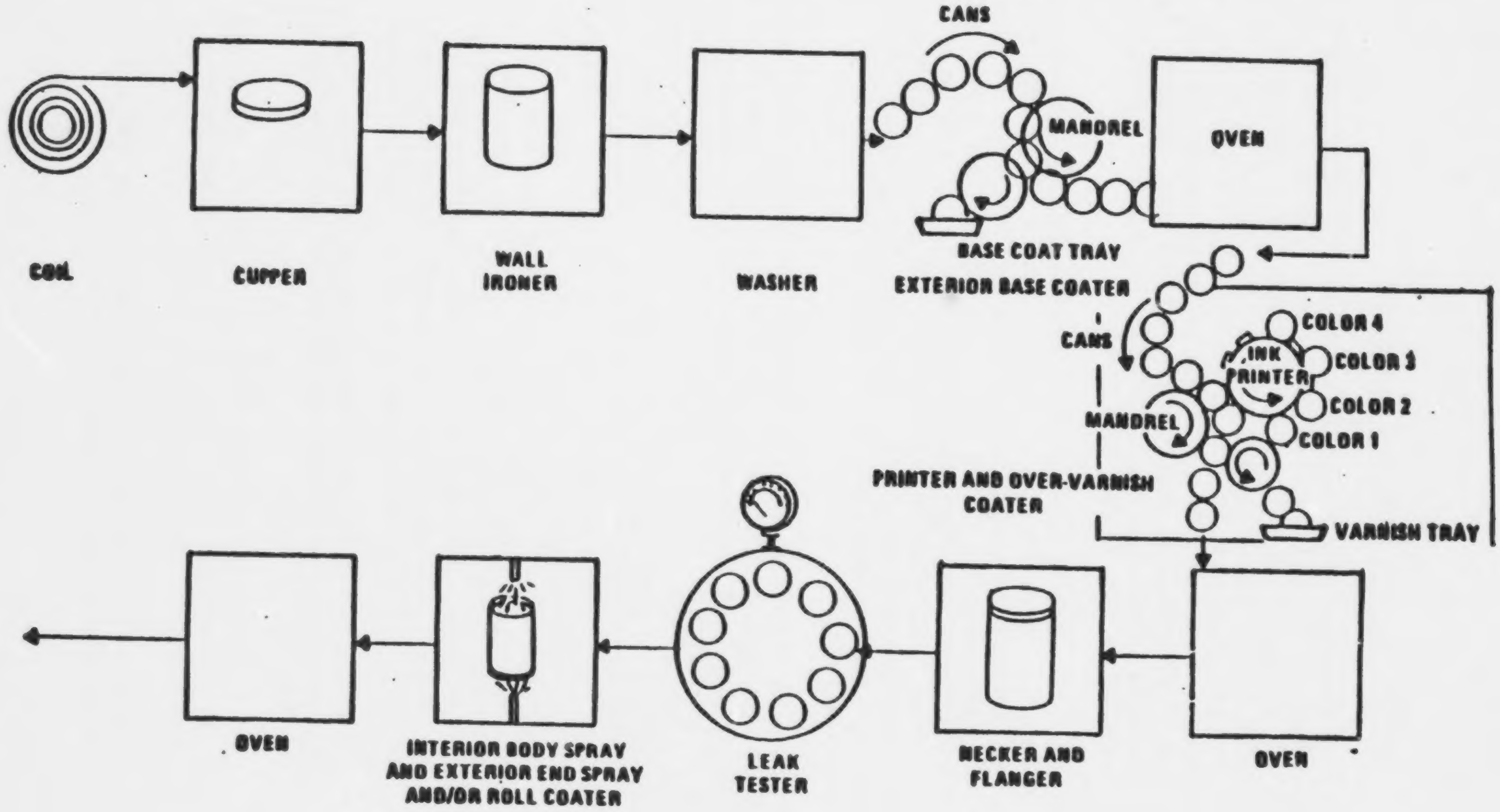
CAN END, AND THREE-PIECE BEER AND BEVERAGE CAN FABRICATING OPERATION


SHEET (PLATE) STACK
COIL
SLITTER
SCROLL STRIP SHEARER
BODY BLANKS
COMPOUND LINER
END FORMER
FORMED
BODY MAKER
SOLDERED OR CEMENTED
SIDE SEAM SPRAY
TAB FORMER
PALLETIZED LOAD
LEAK TESTER
END SEAMER
OVEN
INSIDE BODY SPRAY
NECKER AND FLANGER

Source: U.S. Environmental Protection Agency

- The cans are necked, flanged and tested.
- The interior of the cans are spray coated and baked in the oven.
- An exterior end spray coating is applied:
  - For aluminum cans to prevent blocking
  - For steel cans to prevent rusting.
- Exhibit 3-6, on the following page, is a process diagram of a two-piece can fabricating and coating operation.
- Two-piece cans are largely made from aluminum.
  - Virtually all aluminum cans are of two-piece construction.
  - Aluminum lends itself to two-piece construction, yet offers no advantage to warrant converting three-piece can lines to aluminum.

EXHIBIT 3-6
U.S. Environmental Protection Agency
TWO-PIECE ALUMINUM CAN FABRICATING AND COATING OPERATION


CANS
MANDREL
OVEN
COIL
CUPPER
WALL IRONER
WASHER
BASE COAT TRAY
EXTERIOR BASE COATER
CANS
COLOR 4
INK PRINTER
COLOR 3
COLOR 2
COLOR 1
MANDREL
PRINTER AND OVER-VARNISH COATER
VARNISH TRAY
OVEN
INTERIOR BODY SPRAY AND EXTERIOR END SPRAY AND/OR ROLL COATER
LEAK TESTER
NECKER AND FLANGER
OVEN

Source: U.S. Environmental Protection Agency

3.3.2 Emissions and Current Controls

This section presents the estimated VOC emissions from can manufacturing facilities in Georgia. Exhibit 3-7, on the following page, shows the total emissions from the six can manufacturing facilities in Georgia to be about 3,200 tons per year. No emission controls are reported to be utilized in the state, though a small amount of water-based coatings are reported to be in use. Sources of this information are reports filed with the Georgia Department of Natural Resources, supplemented by interviews with the firms involved.

Exhibit 3-7 also presents a distribution of emissions by type of product. These distributions, which form the basis for later estimates of production, are believed to be generally accurate, based on interviews with the companies involved; but they have not been further verified because of the potential for release of proprietary information. It should be noted, however, that final conclusions are not likely to be grossly affected by changes in the assumptions as to the distribution of the totals between product types.

The can industry is moving toward products with inherently lower VOC emissions during manufacture. Differences in the manufacturing process between two-piece and three-piece cans allow for a 50 percent to 60 percent reduction in emissions in converting from a three-piece beverage can to a two-piece beverage can decorated in a similar manner. This is caused by a greater number of interior coating operations for three-piece cans, as well as a tendency to eliminate certain exterior coatings on two-piece beer and soft drink cans. The exhibits, on the following pages, present the emissions from typical can coating operations based upon average coating properties, can production rates and annual hours of operation. They present data for conventional systems, as well as low solvent systems. It is important to note that, in most instances, can manufacturing does not require all the coatings listed on the exhibits.

- Exhibit 3-8 presents VOCs resulting from coating operations typically involved in the manufacture of two-piece cans.

- Exhibit 3-9 presents VOCs resulting from sheet coating operations typically involved in the manufacture of three-piece cans.

- Exhibit 3-10 presents VOCs resulting from typical three-piece can assembly operations.

EXHIBIT 3-7
U.S. Environmental Protection Agency
1977 EMISSIONS FROM CAN COATING OPERATIONS IN GEORGIA

Facility	Emissions (Tons/Year)	Estimated Distribution of Emissions (Tons/Year)				
		2-piece Beverage Assembly	3-piece Beverage Assembly	3-piece Food and Other Assembly	Sheet Coating Beverage	Sheet Coating Food and Other
American Can Company, College Park	281	-	281	-	-	-
American Can Company, Forest Park	987	-	210	210	320	247
American Can Company, Columbus	64	-	64	-	-	-
Continental Can Group, Forest Park	155	-	155	-	-	-
Continental Can Group, Perry	1,420	1,420	-	-	-	-
Standard Container Company, Homerville	300	-	-	110	-	190
TOTAL	3,207	1,420	710	320	320	437

Note: Distributions are Booz, Allen estimates. These estimates have not been validated with the companies because of the potential for release of proprietary information.

Source: Booz, Allen and Hamilton Inc., analysis of information reported to Georgia Department of Natural Resources, supplemental emissions information provided by specific companies.

EXHIBIT 3-8 (1)
U.S. Environmental Protection Agency
EMISSIONS FOR TYPICAL COATING
OPERATION USED IN THE MANUFACTURE
OF TWO-PIECE CANS

Operation	Coating Properties							
	Density (lb./gal.)	Solids (wt. %)	Organic Solvent (wt. %)	Organic Solvent (lb./gal.)	Water (gal./gal. coating)	VOC (lb. solvent/ gal. less water)	VOC (lb. solvent/ gal. incl. water)	Yield (1000 can/ gal.)
Organic Systems								
Print and varnish	8.0	45	100	4.40	0	4.40	4.40	12
Size and print	8.0	40	100	4.80	0	4.80	4.80	20
White base coat and print	11.0	62.5	100	4.13				
Interior body spray	7.9	26	100	5.85	0	4.13	4.13	9
End coating Al	8.0	45	100	4.40	0	5.85	5.85	6[a]
End coating steel	8.0	45	100	4.40	0	4.40	4.40	200
					0	4.40	4.40	40
Low Solvent Systems								
Waterborne								
Print and varnish	8.5	35	20	1.11	0.53	2.36	1.11	11
Size and print	8.5	30	20	1.19	0.57	2.76	1.19	17
White base coat and print	11.7	62	20	0.89	0.43	1.55	0.88	8
Interior body spray	8.55	20	20	1.37	0.66	3.99	1.36	5[a]
End coating Al	8.5	35	20	1.11	0.53	2.36	1.11	200
End coating steel	8.5	35	20	1.11	0.53	2.36	1.11	40
UV Cure High Solids Print and varnish[b]	8.0	95	100	0.40	0	0.40	0.40	25

---

a. Assuming 75 percent beer cans, all given a single coat, and 25 percent soft drink cans, given a double coating

b. Booz, Allen & Hamilton, Inc. estimate based on data supplied by CMI, individual can manufacturers and the EPA document 450/2-77-008

EXHIBIT 3-8 (2)
U.S. Environmental Protection Agency

Operation	Production		Coating Consumed		VOC		
	(cans/min.)	(Million cans/yr.)	(gal./hr.)	(1000 gal./yr.)	(lb./hr.)	(tons/yr.)	(lb./million cans)
Organic Systems							
Print and varnish	650	253.5	3.25	21.1	14.3	46.5	364
Size and print	650	253.5	1.95	12.7	9.4	30.6	241
White base coat and print	650	253.5	4.33	28.1	17.8	57.9	457
Interior body spray	650	253.5	6.50	42.3	38.0	123.5	974
End coating Al	650	253.5	0.20	1.3	0.9	2.9	23
End coating steel	650	253.5	0.98	6.4	4.3	14.0	110
Low Solvent Systems							
Waterborne							
Print and varnish	650	253.5	3.55	23.1	3.9	12.7	100
Size and print	650	253.5	2.29	14.9	2.7	8.8	69
White base coat and print	650	253.5	4.88	31.7	4.3	14.0	110
Interior body spray	650	253.5	7.80	50.7	10.6	34.5	272
End coating Al	650	253.5	0.20	1.3	0.2	0.7	6
End coating steel	650	253.5	0.98	6.4	1.1	3.6	28
UV Cured High solids							
Print and varnish	650	253.5	1.56	10.1	0.6	2.0	15

Source: Booz, Allen & Hamilton Inc. estimates based on data supplied by Can Manufacturers Institute and interviews with can companies.

EXHIBIT 3-9 (1)
U.S. Environmental Protection Agency
COATING AND PRINTING OPERATIONS USED IN THE MANUFACTURE OF THREE PIECE CANS
(Sheet Coating Operation)

Operation	Coating Properties							Dry Coating Thickness	
	Density (lb./gal.)	Solids (wt %)	Organic Solvent (wt %)	Organic Solvent (lb./gal.)	Water (gal/gal coating)	VOC (lb. solvent/ gal. less water)	VOC (lb. solvent/ gal. including water)	(Mg/4In2)	(lb./basebox)
Conventional Organics Systems									
Sizing and print	8.0	40	100	4.80	0	4.80	4.80	5	0.086
Inside basecoat	8.05	40	100	4.83	0	4.83	4.83	20	0.346
Outside white and print	11.0	62.5	100	4.13	0	4.13	4.13	40	0.692
Outside sheet printing and varnish	8.0	45	100	4.40	0	4.40	4.40	10	0.172
Low Solvent Systems									
Sizing (waterborne)	8.5	30	20	1.19	0.57	2.76	1.19	5	0.086
Inside basecoat									
High solids	8.0	80	100	1.60	0	1.60	1.60	20	0.346
Waterborne	8.8	40	20	1.06	0.51	2.15	1.05	20	0.346
Outside white									
High solids	12.0	80	100	2.40	0	2.40	2.40	40	0.692
Waterborne	11.7	62	20	0.89	0.43	1.55	0.88	40	0.692
Outside sheet print and varnish (waterborne)	8.5	35	20	1.11	0.53	2.36	1.11	10	0.172

EXHIBIT 3-9 (2)
U.S. Environmental Protection Agency

Operation	Production		Coating Consumption			VOC		
	(base box / hr.)	(1000 base boxes[a] / year)	(gallon / basebox)	(gallon / hour)	(1000 gal. / year)	(lb. / hour)	(tons / year)	(lbs. / 1000 base boxes)
Conventional Organics Systems								
Sizing and print	150	240	.027	4.1	6.6	19.7	15.8	130
Inside basecoat	150	240	.107	16.1	25.7	77.8	62.2	517
Outside white and print	150	240	.100	15.0	24.0	62.0	49.6	413
Outside sheet printing and varnish	150	240	.048	7.2	11.5	31.7		211
Low Solvent Systems								
Sizing (waterborne)	150	240	.034	5.1	8.1	6.1	4.9	41
Inside basecoat								
High solids	150	240	.054	8.1	13.0	13.0	10.4	87
Waterborne	150	240	.098	14.7	23.5	15.4	12.3	103
Outside white								
High solids	150	240	.072	10.8	17.3	25.9	20.7	172
Waterborne	150	240	.095	14.3	22.9	12.6	10.1	841
Outside sheet print and varnish (waterborne)	150	240	.057	8.6	13.8	9.5	7.6	63

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[a] Assuming 1,600 hours per year of operation.

Source: Booz, Allen & Hamilton Inc. estimates based on data supplied by Can Manufacturers Institute and interviews with can companies.

EXHIBIT 3-10 (1)

U.S. Environmental Protection Agency
EMISSIONS OF TYPICAL COATING
OPERATIONS USED IN THREE-PIECE
CAN ASSEMBLY

Operation	Coating Properties							
	Density (lb./gal.)	Solids (wt. %)	Organic Solvent (wt. %)	Organic Solvent (lb./gal.)	Water (gal./gal. coating)	VOC (lb. solvent/ gal. less water)	VOC (lb. solvent/ gal. incl. water)	Yield (1000 can/ gal.)
Organic Systems								
Interior body spray (beer)	7.9	26	100	5.85	0	5.85	5.85	4
Inside stripe (beer & bev.)	8.0	13.5	100	6.9	0	6.92	6.92	70
(food)	8.0	13.5	100	6.9	0	6.92	6.92	70
Outside stripe (beer)	8.0	13.5	100	6.9	0	6.92	6.92	50
End sealing compound (beer & bev.)	7.1	39	100	4.3	0	4.33	4.33	10
(food)	7.1	39	100	4.3	0	4.33	4.33	10
Low Solvent Systems (waterborne)								
Interior body spray (beer)	8.55	20	20	1.37	0.66	3.99	1.36	5
Inside stripe (beer & bev.)	8.55	36	20	1.09	0.53	2.30	1.08	70
(food)	8.55	36	20	1.09	0.53	2.30	1.08	70
Outside stripe (beer)	8.55	36	20	1.09	0.53	2.30	1.08	45
End sealing compound (beer & bev.)[a]	9.00	40	3	0.16	0.63	0.43	0.16	10
(food)[a]	9.00	40	3	0.16	0.63	0.43	0.16	10

3-12-F

EXHIBIT 3-10 (2)
U.S. Environmental Protection Agency

Operation	Production Rate[b]		Coating Consumed		VOC		
	(cans/min.)	(Million cans/yr.)	(gal./hr.)	(1000 gal./yr.)	(lb./hr.)	(tons/yr.)	(lb./million cans)
Organic Systems							
Interior body spray (beer)	400	120	6.00	30.0	35.1	87.8	1,463
Inside stripe							
(beer & bev.)	400	120	0.30	1.5	2.1	5.3	88
(food)	400	72	0.30	0.9	2.1	3.2	88
Outside stripe (beer)	400	120	0.48	2.4	3.3	8.3	138
End sealing compound							
(beer & bev.)	400	120	2.40	12.0	10.4	26.0	433
(food)	400	72	2.40	7.2	10.4	15.6	433
Low Solvent Systems (Waterborne)							
Interior body spray (beer)	400	120	4.8	24.0	6.5	16.3	272
Inside stripe							
(beer & bev.)	400	120	0.30	1.5	0.3	0.8	13
(food)	400	72	0.30	0.9	0.3	0.5	13
Outside stripe (beer)	400	120	0.53	2.6	0.6	1.5	25
End sealing compound							
(beer & bev.)[a]	400	120	2.40	12.0	0.4	1.0	17
(food)[a]	400	72	2.40	7.2	0.4	0.6	17

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[a] Waterborne systems are currently only used on aerosol and oil cans.

[b] Assumes 4,000 hours per year, as an average of 3,000 hours for food cans and 5,000 hours for beer and beverage cans.

Source: Booz, Allen & Hamilton Inc. estimates based on data supplied by CMI and individual can companies

3.3.3 RACT Guidelines

The RACT Guidelines for VOC emission control are specified as the amount of allowable VOC, in pounds per gallon of coating, minus any water in the solvent system. To achieve this guideline, RACT suggests the following options:

- Low solvent coatings
  - Waterborne
  - High solids
  - Powder coating
  - Ultraviolet curing of high solids coatings.
- Incineration
- Carbon adsorption.

The RACT guidelines have established different limitations for each of four groups of can coating operations. Exhibit 3-11, on the following page, presents the recommended VOC limitations, compared with typical, currently available, conventional coatings.

3.3.4 Selection of the Most Likely RACT Alternatives

Projecting the most likely industry response for control of VOC emissions in can manufacturing facilities is complicated by the thousands of different products offered by the can industry. Several general assumptions can be made.

- The industry preferred response will be to use low solvent coatings (primarily waterborne) wherever technically feasible.
  - The choice between thermal incinerators and catalytic incinerators will be based on the availability of fuel and the preference of the individual companies.
  - Incinerators with primary heat recovery will be used in preference to those with secondary recovery or no heat recovery.
- The industry is not likely to install carbon adsorption systems because of the very poor performance record of this control technique within the can manufacturing industry.

EXHIBIT 3-11
U.S. Environmental Protection Agency
RACT GUIDELINES FOR CAN COATING OPERATIONS

Coating Operation	Recommended Limitation		Typical Currently Available Conventional Coatings
	kg. per liter of coating (minus water)	lbs. per gallon of coating (minus water)	lbs. per gallon of coating (minus water)
Sheet basecoat (exterior and interior) and overvarnish; two-piece can exterior (basecoat and overvarnish)	0.34	2.8	4.1-5.5
Two- and three-piece can interior body spray, two-piece can exterior end (spray or roll coat)	0.51	4.2	6.0
Three-piece can side-seam spray	0.66	5.5	7.0
End sealing compound	0.44	3.7	4.3

Source: U.S. Environmental Protection Agency

- Ten likely control alternatives, as well as the three base cases, are discussed in the paragraphs below. The percentage of each type of can likely to be manufactured by each of the control option alternatives, by 1982, is summarized in Exhibit 3-12, on the following page. This distribution was based on interviews with can companies and relates to the entire U.S. market. The resulting emissions per million cans, based on these distributions and the cases described below, are summarized in Exhibits 3-13 and 3-14, at the end of this section. For cases involving incineration, the following assumptions were made.

  - Incinerator air flow is assumed to be 8,000 cubic feet (CF) per pound of solvent entering the incinerator:

    - Incineration air inlet temperature equals 300°F.

    - Lower explosive limit (LEL) is 2,500 CF per gallon of solvent at an inlet temperature of 70°F. or 3,600 CF per gallon at 300°F.

    - The incinerator operates at 10 percent of the LEL, thus requiring 36,000 CF of inlet air per gallon of solvent.

    - Assuming an average solvent density of 4.5 pounds per gallon, the airflow is 8,000 CF per pound of solvent entering the incinerator.

  - 90 percent of the roller coating emissions are collected and incinerated; the balance escapes as fugitive emissions within the plant.

  - 30 percent of the interior spray coating emissions are collected and incinerated; the balance escapes as fugitive emissions.

EXHIBIT 3-12
U.S. Environmental Protection Agency
PERCENTAGE OF CANS MANUFACTURED USING EACH ALTERNATIVE

Can Type	Water-borne or Other Low Solvent Coatings	Thermal Incineration with Primary Heat Recovery	Print Only, All Low Solvent Coatings	Low Solvent Coatings Except End Sealant Which Is Incinerated	UV Cured Outside Varnish Waterborne Inside Spray
2-piece beer and soft drink	40	—	60	--	0
3-piece beer and soft drink	25	20	--	55	--
3-piece food and other cans	25	20	--	55	--

Source: Booz, Allen & Hamilton Inc.

- The theoretical energy consumption was assumed to be the total energy required to heat the air, less a credit for the heat content of the solvent and heat recovered in the primary heat exchanger.
    - The theoretical energy consumption in heating air from 300°F to an incineration temperature of 1100°F is 15.6 BTU/CF.
    - Assuming the furnace operates at 90 percent efficiency, the energy requirement would be 16.2 BTU/CF.
    - The heat content of the solvent is assumed to be 16,000 BTU per pound or 2 BTU per cubic foot of inlet air solvent mixture, reducing the total, external energy demand 14.2 BTU/CF.
    - However, the furnace recovers 60 percent of the heat in a heat exchanger, reducing the energy requirements to 5.7 BTU/CF.
- The energy cost was assumed to be $2.25 per million BTU.
- The capital cost of an incinerator was assumed to be $20,000 per 1,000 CFM installed based on industry interviews. Thus, 7.5 pounds of solvent per hour can be incinerated in a $20,000 incinerator at a fuel cost of $0.77.

3.3.4.1 Two-Piece Beer and Soft Drink Cans--1978 Base Case

At the present time, the majority of beer and soft drink cans are produced with one exterior coating, a procedure defined as print and varnish.

- The can is printed directly over the base metal and then varnished using a high solvent organic-borne varnish--eliminating the base coat.

- The interior of the can is sprayed, using a high solvent interior body spray.

- The end of the can is spray coated, using a high solvent body spray.

The coating consumption is approximately 250 gallons per million cans, resulting in emissions of 0.67 tons per million cans.

3.3.4.2 Two-Piece Beer and Soft Drink Cans--Waterborne Coatings as Proposed in RACT

In this alternative, all the coating operations currently employed in the base case are assumed to have been converted to waterborne coatings. The cost of converting to waterborne systems was assumed to be minimal.

- The capital cost for converting each of three coating operations was estimated to be $10,000. This results in an annualized cost of $30 per million cans--assuming that the annualized cost of capital is 25 percent of the total installed capital cost and that 250 million cans are produced annually on the coating line.[1]

- The cost of the coatings is the same as for conventional coatings--industry sources believe that by 1980 this will be the case.

- The energy consumption is the same--this would appear reasonable since most energy consumed is used to heat the belt and the metal cans.

- The yield (spoilage) is the same--it appears that the industry will continue to encounter significant spoilage in changing over to new coatings. However, as the technology is established, it is assumed that spoilage will decline to levels currently experienced.

The total incremental annualized compliance cost of using waterborne solvents is estimated to be about $30 per million cans. This represents a direct cost increase of less than 0.05 percent. The emissions would be reduced to 0.19 tons per million cans--a 75 percent reduction at a cost of about $62 per ton of VOC removed.

It is estimated that 40 percent of the two-piece beer and soft drink cans would be produced using this alternative by 1981.

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[1] Annualized capital cost includes depreciation, interest, taxes, insurance and maintenance.

3.3.4.3 Two-Piece Beer and Soft Drink Cans--Base Case with Thermal Incinerators and Primary Heat Recovery

This alternative assumes that all coating operations currently employed in the base case are retrofitted with thermal incinerators. This alternative is presently employed on several two-piece can lines in other states. As a basis for calculation the following configuration is assumed:

- The capital required for incinerators would be about $66,000--at $20,000 installed cost per thousand CFM.
- The annualized capital cost would be about $66 per million cans.
- The energy costs to operate the incinerators would be about $62 per million cans, at $2.25 per million BTUs.
- Material cost would be comparable to the base case.

The total incremental cost to incinerate emissions from conventional coatings would be about $128 per million cans. This represents a cost increase of approximately 0.2 percent, to reduce emissions by about 42 percent to 0.39 tons per million cans. The reason for the low overall efficiency is that a considerable portion of the VOC escapes as fugitive emissions prior to incineration.

- 90 percent of the exterior coating emissions reach the incinerator.
- 30 percent of the interior spray coating emissions reach the incinerator.

The cost of incineration is about $441 per ton of emission removed. It is estimated that no two-piece can production will utilize this alternative by the end of 1981 because of the high cost and because satisfactory water-based coatings are expected to be available.

3.3.4.4 Two-Piece Beer and Soft Drink Cans--Supplementary Scenario I

This alternative is based upon combining low solvent coatings with industry product trends that lower the product cost. It includes:

- Print only, eliminating all coating operations--this is used for some aluminum cans at the present time
- Waterborne interior body spray as proposed by RACT
- End coatings using a low solvent varnish--either waterborne or high solids.

The elimination of one coating operation would result in a net savings of about $750 per million cans, composed of a material savings of about $540 and an energy savings of about $230 per million cans. The incremental capital cost would be $20 per million cans. Emissions are reduced by 79 percent to 0.14 tons per million cans, at a savings of about $1,450 per ton of emissions reduced or about $1,300 per ton of emission controlled. It is estimated that 60 percent of the cans produced in 1982 will utilize this method.

3.3.4.5 Two-Piece Beer and Soft Drink Cans--Supplemental Scenario II

This scenario is based upon the use of an experimental UV cured varnish, a waterborne interior body spray and an end coating using a low solvent varnish.

Because of the current high cost of UV cured varnishes, this approach is only experimental. Based on today's prices of about $6.50 per gallon for conventional varnishes and $16.25 for UV cured varnishes, this is the most expensive approach to emission reduction, about $734 per million cans.

- The incremental varnish cost is about $810 per million cans.
- The energy saving is about $105 per million cans.
- The annualized capital cost for converting the coating systems to UV cured and waterborne coatings is about $30 per million cans.

This scenario provides a 78 percent reduction in emissions from the base case, to 0.15 tons per million cans at a cost of about $1,400 per ton of emission reduced. Because of the high cost, it is not expected that this approach will be implemented by 1982.

3.3.4.6 Three-Piece Beer and Soft Drink Cans--Base Case

At the present time, the majority of three-piece beer and soft drink cans are produced by the following coating operations:

- Interior base coat
- Decoration and over varnish
- Interior and exterior stripe
- Interior spray coating
- End sealant.

The production of beer cans differs from the production of soft drink cans in some respects, the impact of which has not been considered in this study.

- Beer cans almost always have an exterior stripe, but soft drink cans frequently do not.
- Beer cans always have an inside spray coating but soft drink cans usually do not. However, soft drink cans frequently have a heavier inside base coat to offset the elimination of the spray coating.

Consideration of these and a variety of other differences has been eliminated to reduce the complexity of the study. Because of the declining importance of three-piece beer and beverage cans, the impact of errors resulting from these simplifying assumptions will be smaller in 1982 than it would be currently.

The total emissions from this alternative are 1.79 tons per million cans (2.5 times the emissions from a similar two-piece can).

3.3.4.7 Three-Piece Beer and Soft Drink Cans--Waterborne Coatings as Proposed in RACT

In this alternative, all the coating operations currently employed in the base case are assumed to be converted to waterborne coatings. The cost of converting to waterborne systems was assumed to be minimal.

- The capital cost for converting each of five operations on the coating line was assumed to be $10,000. This results in an annualized capital cost of $104 per million cans--assuming that the cost of capital and maintenance is 25 percent of the total installed capital cost and that 120 million cans are produced annually on the coating line.

- The raw material cost of coatings is the same as for conventional coatings.

- The energy consumption is the same--this would appear reasonable since most of the energy is consumed to heat the wickets, belts and the can metal.

- The yield (spoilage) is the same--it appears that the industry will continue to encounter significant spoilage in changing over to new coatings. However, as the technology is established, it is assumed that spoilage will decline to current levels.

The total incremental cost to convert to waterborne coatings is estimated to be about $100 per million cans. This represents a cost increase of about 0.15 percent. The emissions would be reduced to 0.34 tons per million cans, an 80 percent reduction at a cost of about $72 per ton.

It is estimated that 25 percent of all beer and soft drink facilities will employ this option for all their cans. The acceptance of this technology will be retarded by the lack of a complete line of available coatings. Thus, even if the bulk of the applications can be converted to water-based coating systems, many lines will operate with solvent-based systems part of the time and will, therefore, require installation of control devices.

3.3.4.8 Three-Piece Beer and Soft Drink Cans--Base Case with Thermal Incinerators and Primary Heat Recovery

This alternative assumes that all coating operations currently employed in the base case are retrofitted with thermal incinerators. Thermal incinerators are currently being employed on a number of coating lines in other states.

The capital required for incinerators to control the five emissions sources on a typical line would be about $320,000--assuming an installed cost of $20,000 per 1,000 CFM.

- The annualized capital cost would be about $668 per million cans.

- The energy cost to operate the incinerators would be $166 per million cans.

- The material costs would be the same as the base case.

The total incremental cost of adopting thermal incineration is estimated to be about $834 per million cans. This represents a cost increase of about 1.0 percent. The emissions would be reduced by 59 percent to 0.74 tons per million cans at a cost of $794 per ton of emissions removed. Because of the high costs of this alternative, it is estimated that it will be employed only on 20 percent of all three-piece beer and soft drink cans manufactured in Georgia in 1982.

3.3.4.9 Three-Piece Beer and Soft Drink Cans--All Waterborne Except End Sealant, Which Is Thermally Incinerated

It is likely that the can industry will adopt a hybrid system which will focus on waterborne or possibly other low solvent coatings and thermal incineration of the end sealant and which probably will not be universally available by 1982. Because end sealing compounds represent approximately 12 percent of the VOC from three-piece beer and soft drink can manufacture, this case was developed under the assumption that technology-based exceptions will not be granted.

- The capital cost of converting four coating operations and adding one incinerator would be about $340 per million cans.
- The additional energy costs of one incinerator would be about $93 per million cans.
- Material cost would be the same.

The total incremental cost of this scenario would be about $171 per million cans. This represents a cost increase of about 0.2 percent, to reduce emissions by 80 percent. It is estimated that about 55 percent of the beer and soft drink cans will be produced using this technology.

3.3.4.10 Three-Piece Food Cans--Base Case

Three-piece food cans are currently produced utilizing the following coating operations:

- Interior base coat
- Exterior base coat
- Interior stripe
- End sealant.

The emissions from this case are estimated to be 0.99 tons per million cans.

3.3.4.11 Three-Piece Food Cans--Waterborne as Proposed in RACT

In this alternative, all the coating operations currently employed in the base case have been converted to waterborne coatings.

The total incremental cost to convert to waterborne coatings is estimated to be $113 per million cans. A 76 percent reduction in emissions is achieved, to 0.24 tons per million cans. It is unlikely that a complete spectrum of waterborne coatings will be available to meet industry requirements by 1982 because the need to achieve FDA approval for the broad spectrum of products required has caused coating manufacturers to focus their product development on the large-volume coatings required for two-piece beer and soft drinks.

As a result, it is estimated that only 25 percent of the cans will be produced using this control approach.

3.3.4.12 Three-Piece Food Cans--Base Case with Thermal Incinerators and Primary Heat Recovery

This alternative assumes that all coating operations currently employed in the base case are retrofitted with thermal incinerators.

The total incremental cost of adopting this approach is estimated to be about $690 per million cans; about $595 in capital cost and $95 in energy costs. Emissions would be reduced by 81 percent, to 0.19 tons per million cans. An estimated 20 percent of the cans would be produced using this approach.

3.3.4.13 Three-Piece Food Cans--All Waterborne Except End Sealant, Which Is Thermally Incinerated

Because waterborne and other low solvent coatings are not yet available for many applications, it is likely that the industry will develop a hybrid approach utilizing waterborne coatings where available and incinerating the balance of the emissions. The end sealing compound appears to be the coating most likely to be unavailable in low solvent form by 1982--end sealing compounds release about 18 percent of the VOC emissions from food can manufacturing operations.

The total incremental cost of this scenario is about $200 per million cans; $500 in capital cost and $100 in energy costs. The emissions are reduced by about 79 percent to 0.25 tons per million cans. It is estimated that 55 percent of the cans would be produced using this approach.

3.3.4.14 Sheet Coating Feeder Plant--Low Solvent As Proposed in RACT

In this alternative, all the sheet coating and end compounding operations will be converted to waterborne. The total incremental cost to convert to waterborne is estimated to be about $15 per million cans. It is unlikely that a complete spectrum of waterborne coatings will be available to meet industry requirements by 1982; as a result, 60 percent of the stock will be coated with waterborne coatings. However, because sheet coating lines are commonly used to make a variety of cans, 80 percent of the lines would still need to be controlled with incineration.

* * * *

Exhibit 3-13, on the following page, summarizes the emissions and incremental cost of each of the alternatives described above for two-piece cans, per million cans produced under that alternative. Exhibit 3-14, following Exhibit 3-13, presents similar data for the three-piece can control options discussed above.

EXHIBIT 3-13
U.S. Environmental Protection Agency
EMISSIONS FROM COATING TWO-PIECE ALUMINUM BEER AND SOFT DRINK CANS PER MILLION CANS

Alternative		Annualized Incremental Costs					Emissions			
	Capital ($)	Annualized Capital Cost ($)	Materials ($)	Energy ($)	Total ($)	Coating Input (gal.)	VOC Emissions (tons)	VOC Decrease (tons)	VOC Decrease %	Incremental Cost (per ton)
1978 BASE CASE Print and varnish Nonconfirming interior body spray (exempt solvents) End coating	0	0	0	0	0	250	0.67	a	a	a
WATERBORNE AS PROPOSED IN RACT	120	30	0	0	30	340	0.19	0.48	75	63
BASE CASE WITH THERMAL INCINERATORS & PRIMARY HEAT RECOVERY	266	66	0	62	128	250	0.39	0.29	42	441
SUPPLEMENTAL SCENARIO 1 Print only Waterborne interior body spray End coating using a low varnish solvent	80	20	(540)	(230)	(750)	200	0.14	0.53	79	1415
SUPPLEMENTAL SCENARIO 2 Print UV cured varnish Waterborne interior body spray End coating using a low solvent varnish	120	30	810	105	734	240	0.15	0.52	78	1411

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a. Not Applicable

Source: Booz, Allen & Hamilton Inc. estimates

EXHIBIT 3-14
U.S. Environmental Protection Agency
EMISSIONS FROM COATING THREE-PIECE CANS PER MILLION CANS

Case	Annualized Incremental Costs					Coating And Emissions				
	Capital ($)	Annualized Capital Cost/Millions ($)	Materials ($)	Energy ($)	Total ($)	Coating Input (gal.)	VOC Emissions (tons)	VOC Decrease (tons)	VOC Decrease %	Incremental Cost ($ per ton)
BEVERAGE CANS										
1978 BASE CASE[b] Interior base coat Decoration and/or varnish Interioring and exterioring stripe Interior spray End sealant	0	0	0	0	0	894	1.79	a	a	a
WATERBORNE AS PROPOSED IN RACT	416	104	0	0	104	720	0.34	1.45	81	72
BASE CASE WITH THERMAL INCINERATORS AND HEAT RECOVERY PRIMARY	2670	668	0	166	834	694	0.74	1.05	59	794
SUPPLEMENTAL SCENARIO 3 Waterborne except end sealant which is incinerated	686	171	0	20	191	715	0.35	1.44	80	133
FOOD CANS										
1978 BASE CASE[c] Interior base coat Exterior base coat Interior stripe End sealant	0	0	0	0	0	424	0.99	a	a	a
WATERBORNE AS PROPOSED IN RACT	453	113	0	95	208	439	0.24	0.75	76	151
BASE CASE WITH THERMAL INCINERATORS AND PRIMARY HEAT RECOVERY	2380	595	0	95	687	424	0.19	0.80	81	859
SUPPLEMENTAL SCENARIO 4 All waterborne except end sealant which is incinerated	768	192	0	17	209	435	0.23	0.76	77	275

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a. Not Applicable
b. Beverage Soft Drink Cans
c. Food and Other Cans

Source: Booz, Allen & Hamilton Inc.

3.4 COST AND VOC BENEFIT EVALUATIONS FOR THE MOST LIKELY RACT ALTERNATIVES

Cost and benefit evaluation for alternative VOC emission controls are presented in this section based upon the costs per million cans that were developed in the previous section. The extrapolation to statewide industry costs is based upon total can production and emissions for the typical can manufacturing processes. It is not based upon the representative plants.

3.4.1 Costs for Alternative Control Systems

Although there is no typical can manufacturing facility, the following four representative plants describe the situation in most can manufacturing facilities.

- Representative Plant A produces two-piece beer and soft drink cans on two lines. Each line operates at 650 cans per minute for 6,500 hours annually, to produce approximately 250 million cans--total plant production is 500 million cans.

- Representative Plant B produces 80 percent three-piece beer and soft drink cans and 20 percent three-piece food cans using three assembly lines. The sheet coating lines operate at 2.5 base boxes per minute for about 4,000 hours per year, to support the three assembly lines. Each can assembly line operates at 400 cans per minute, the beer lines for 5,000 hours annually and the food can lines for 3,000 hours annually.

- Representative Plant C coats and decorates flat stock for use in satellite assembly plants. The plant coats at 2.5 base boxes per minute. Its operating rate is approximately 1,000 hours per satellite plant production line. Assuming the plant supports four lines, its operating rate would be 4,000 hours annually.

- Representative Plant D produces food cans from precoated stock. It contains two can assembly lines, each of which operates at 400 cans per minute for 5,000 hours annually. The total plant production is 144 million cans.

The capital cost to adopt the alternative controls to the four representative plants ranges from $20,000 (to convert the can assembly plant to waterborne coatings) to more than $400,000 (to retrofit the three-piece coating and assembly plant with incinerators). The incremental operating costs (energy plus 25 percent of capital) range from a savings of $375,000 (for the two-piece beer and soft drink plant that was converted to "print only") to a cost of $387,000 (for operating incinerators at the three-piece coating and assembly plant). Capital and annual operating costs for each of the representative plants are presented for each applicable alternative on Exhibit 3-15, on the following page.

3.4.2 Extrapolation of the Costs to the Statewide Industry

The costs developed are incremental costs based on the production volume and mix estimate for 1977. Industry changes related to plant closings, conversion to two-piece lines, consumption patterns or other areas not directly related to RACT implementation were not included. One exception is that the trend to print-only on existing lines was addressed and the portion allocated to RACT was estimated and included in the final figures.

Extrapolation of the costs to the statewide industry requires first that the industry in the state of Georgia be segmented. That segmentation and the inferred production of each segment are shown in Exhibit 3-16, following Exhibit 3-15. The exhibit shows the method by which the production was estimated, starting with the estimated emissions, presented in Exhibit 3-7, and relating these to the factors developed from Exhibits 3-8, 3-9 and 3-10 and presented in Exhibits 3-13 and 3-14.

Exhibit 3-17, following Exhibit 3-16, shows an extrapolation of the cost of VOC emission control to the state of Georgia. The cost were developed by undertaking the following steps:

1. Distribute the estimated can production (Exhibit 3-16) by the percentage of cans manufactured using each alternative (Exhibit 3-12). This distribution appears under the heading "Can Production" on Exhibit 3-17. An adjustment was made in the three-piece beverage can figure for the estimated volume of sheet coated in other states.

2. Multiply these numbers by the applicable figures in Exhibits 3-13 and 3-14. For example, to calculate the capital investment for three-piece beer and soft drink cans controlled by thermal incineration, multiply the following figures:

    - 110 million cans. This figure appears in Exhibit 3-17 under Can Production, Thermal Incineration, three-piece beer and soft drink cans.

EXHIBIT 3-15
U.S. Environmental Protection Agency
COST OF IMPLEMENTING RACT ALTERNATIVES FOR
REPRESENTATIVE CAN MANUFACTURING PLANTS ($1,000)

Representative Plant	Waterborne		Thermal Incinerators		Print Only/Waterborne		UV Cured/Waterborne		Waterborne Incinerate End Sealant	
	Capital	Annual Expense	Capital	Annual Expense	Capital	Annual Expense	Capital	Annual Expense	Capital	Annual Expense
A. 2-piece beer & soft drink can 2 lines 500 million cans	60	15	132	64	40	(375)	60	367	a	a
B. 3-piece beer & soft drink and food can coating and assembly plant 1 coating line 1 sheet varnish line 3 assembly lines 310 million cans	100	25	415	387	a	a	b	b	138	106
C. Sheet coating facility for 50% beer cans & 50% food cans 1 sheet coating line 1 sheet varnishing line 1 end compounding line Produces 135,000 base boxes Supplies stock for 290 million cans	30	8	255	143	a	a	b	b	82	34
D. Food can assembly plant 2 assembly lines with inside striping 144 million cans	20	5	60	20	a	a	b	b	a	a

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a. Not applicable
b. Not considered to be a likely response by 1982

Source: Booz, Allen & Hamilton Inc. estimates

EXHIBIT 3-16
U.S. Environmental Protection Agency
CALCULATION OF INFERRED PRODUCTION OF CANS AND SHEET STOCK IN GEORGIA

Type of Product	Estimated Emissions[a] (tons)	Emissions Factor (tons per million cans)[b]	Inferred Production[c] (million cans)
2-piece beverage cans	1,420	0.67	2,120
3-piece beverage cans			
Assembly	710		
Sheet coating	320		
Out-of-state estimate	160	1.79	665
Subtotal	1,190		
3-piece food cans			
Assembly	320		
Sheet coating	437	0.99	765
Subtotal	757		
TOTAL	3,367		3,550

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a. Includes estimates of emissions incurred in the production of sheet shipped from out-of-state, derived from industry interviews
b. From Exhibits 3-13 and 3-14
c. Calculated by dividing estimated emissions by emission factor

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 3-17(1)
U.S. Environmental Protection Agency
COST OF COMPLIANCE TO RACT FOR THE
CAN MANUFACTURING INDUSTRY IN GEORGIA

CAN TYPE	Can Production (millions of units)					Capital Investment (thousands of $)				
	Water-borne or Other Low Solvent Coatings	Thermal Incineration with Primary Heat Recovery	Print Only, All Low Solvent Coatings	Low Solvent Coatings Except End Sealant Which Is Incinerated	Total	Water-borne or Other Low Solvent Coatings	Thermal Incineration with Primary Heat Recovery	Print Only, All Low Solvent Coatings	Low Solvent Coatings Except End Sealant Which Is Incinerated	Total
2-Piece Beer and Soft Drink Cans	850	0	1,270	a	2,120	100	0	100	a	200
3-Piece Beer and Soft Drink Equivalent[b]	130	110	a	290	530	50	290	0	200	540
3-Piece Food and Other Cans	190	150	a	420	760	90	360	a	320	770
Total[a]	1,170	260	1,270	710	3,410	240	650	100	520	1,510
Amount Not Resulting From RACT						a	a	50	a	50
Total Applicable To RACT						240	650	50	520	1,460

325-e

EXHIBIT 3-17(2)
U.S. Environmental Protection Agency

CAN TYPE	Annual Compliance Cost (thousands of $)					Emission Reduction (tons)					
	Water-borne or Other Low Solvent Coatings	Thermal Incineration with Primary Heat Recovery	Print Only, All Low Solvent Coatings	Low Solvent Coatings Except End Sealant Which Is Incinerated	Total	Water-borne or Other Low Solvent Coatings	Thermal Incineration with Primary Heat Recovery	Print Only, All Low Solvent Coatings	Low Solvent Coatings Except End Sealant Which Is Incinerated	Total	Annual Unit Cost of Emission Reduction ($ per ton)
2-Piece Beer and Soft Drink	30	0	(950)	a	(920)	410	0	670	a	1,080	(850)
3-Piece Beer and Soft Drink equivalent[b]	10	90	a	60	160	190	120	a	420	730	220
3-Piece Food and Other Cans	40	100	a	90	230	140	120	a	320	580	400
TOTAL	80	190	(950)	150	(530)	740	240	670	740	2,390	(220)
Amount not RACT[c]	a	a	(1,010)	a	1,010	a	a	330	-	330	
Total RACT	80	190	65	150	480	740	240	340	740	2,060	233

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a. Not applicable

b. Adjusted downward by 20 percent to allow for sheet coating done out-of-state (33% of sheet times 60% of emissions from sheet coating).

c. The trend to print only is expected to occur even in the absence of RACT regulations. Therefore the costs and emission reductions related to this are subtracted from the total.

Source: Booz, Allen & Hamilton, Inc.

- $2,670. This figure appears in Exhibit 14, under capital costs for the first base case with incinerators.
- The product is $293,000 which was rounded to $290,000 and positioned in the Exhibit 3-17 matrix.

3. After all similar calculations were completed the cost for each type of can and each control alternative was totaled.
4. Annual unit cost of emission reduction was calculated by dividing the annual compliance cost by the total emission reduction for each can type and for the total.

Based on the above assumptions, the differential costs are estimated at $1.51 million in capital expenses. Because of the annual cost savings involved, the industry will probably take the steps indicated for two-piece cans whether or not the regulation is in place. Thus, the full cost cannot be credited to the RACT regulation. The capital cost applicable to the regulation is estimated at $1.46 million. Annual compliance costs, on the same basis, are projected to be $480,000. The bulk of this represents capital related costs and energy cost for incineration.

Annual unit cost of emission reduction is estimated to be $230 per ton. Three-piece food and other cans have the highest unit cost, $400 per ton.

The substantial cost of developing, testing and obtaining FDA approval of low solvent coatings has not been included in this evaluation, because it is outside the scope of this study and the bulk of it will probably be incurred at the national level. An evaluation of these costs and the degree to which they should properly be allocated to each state must be undertaken on a national basis.

A factor that should be taken into account is that the analysis assumes that production lines will be converted in proportion to the number of cans made by each production mode. Where a single line makes several types of cans, a portion of which can be converted to low solvent systems, the production line might still require installation of afterburner control under RACT requirements, though its use would only be intermittent. The potential effect of this on the cost estimates is difficult to quantify. It is discussed below.

If we assume that all sheet coating and assembly lines were required to install incinerators, to maintain capability to utilize both conventional and low solvent coatings, the projections would be changed as follows:

- Capital expenditure would be increased by $1,400,000, or 93 percent.

- Annual cost would increase by $350,000, or 73 percent. This represents the capital related costs only.

- Emissions reduction estimates would be unchanged.

The figures presented above represent outside limits with actual experience likely to fall somewhere between the two figures. Since most of the can fabrication facilities in Georgia are dedicated to beverage cans, for which low solvent coating systems are likely to be developed by 1982, the effect of this capability maintenance factor will be felt on relatively few production lines.

3.5 DIRECT ECONOMIC IMPLICATIONS AND SELECTED SECONDARY IMPACTS

This section presents the direct economic implications of implementing RACT controls to the statewide industry, including: availability of equipment and capital; feasibility of the control technology; and impact on economic indicators, such as value of shipments, unit price, state economic variables and capital investment.

3.5.1 RACT Timing

RACT must be implemented statewide by January 1, 1982. This implies that can manufacturers must have either low solvent coatings or VOC control equipment installed and operating within the next three years. The timing of RACT imposes several requirements on can manufacturers including:

- Obtaining development quantities of low solvent coatings from their suppliers and having them approved by their customers
- Having coating makers obtain FDA approval where necessary
- Obtaining low solvent coatings in sufficient quantity to meet their volume requirements
- Acquiring the necessary VOC control equipment
- Installing and testing incinerators or other VOC control equipment to insure that the system complies with RACT.

The sections which follow discuss the feasibility and the economic implications of implementing RACT within the required timeframe.

3.5.2 Feasibility Issues

Technical and economic feasibility issues implementing RACT controls are discussed in this section.

The can manufacturing industry, in conjunction with coating suppliers and incinerator vendors, has extensively evaluated most of the approaches to meeting RACT. The feeling in the industry is that, except for one notable exception, RACT can be achieved by January 1, 1982, using low solvent coatings--primarily waterborne. The coating most likely to be unavailable in 1982 is the end sealing compound. The physical characteristics of this material, as well as its method of application, do not lend themselves to incineration. Currently, the coating is air dried over a period of 24 hours.

The can manufacturers have shut down a significant number of three-piece can manufacturing facilities. It appears likely that the implementation of RACT might accelerate this trend because of the lower cost of compliance with two-piece cans and the probable reluctance on the part of can manufacturers to invest capital in facilities producing products with declining demand.

3.5.3 Comparison of Direct Cost with Selected Direct Economic Indicators

This section presents a comparison of the net increase in the annual operating cost of implementing RACT with the total value of cans sold in the state, the value of wholesale trade in the state and the unit price of cans.

The net incremental operating cost from the uncontrolled level to can manufacturers is estimated to be 0.48 million, or 0.17 percent of current value of shipments.

3.5.4 Ancillary Issues Relating to the Impact of RACT

This section presents two related issues that were developed during the study.

The Can Manufacturing Institute has proposed an option to the RACT to encompass a plantwide emissions basis. This would allow a credit from one operation, where emissions were reduced to below the RACT recommended level, to be applied to another operation that is not in compliance. The plant would be in compliance if the total emissions were reduced to the level proposed in RACT. It appears that the impact of this alternative would be to permit can manufacturers to comply without investing heavily to control a small proportion of emissions.

High solvent coatings represent a considerable fire hazard. The conversion to low solvent coatings has reduced fire insurance costs for at least one can manufacturing facility.

* * * *

Exhibit 3-18, on the following page, presents a summary of the current economic implications of implementing RACT for can manufacturing plants in the State of Georgia.

EXHIBIT 3-18
U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR CAN MANUFACTURING PLANTS IN THE STATE OF GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	There are six can manufacturing facilities
Indication of relative importance of industrial section to state economy	The 1977 value of shipment was about $290 million.
Current industry technology trends	Beer and beverage containers rapidly changing to two-piece construction
VOC emissions	3,200 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Low solvent coatings (waterborne) with incineration as an interim approach for older facilities
Affected Areas in Meeting RACT	
Capital investment (statewide)	$1.5 million
Annualized cost (statewide)	$10.5 million
Price	Assuming a direct pass-through of costs, no significant change in price
Energy	2,000 equivalent barrels of oil annually to operate incinerators
Productivity	No major impact
Employment	No major impact
Market structure	Accelerated technology conversion to two-piece cans
Problem area	Low solvent coating technology for end sealing compound
VOC emission after control	820 tons per year (25 percent of current emission level)[a]
Cost effectiveness of control	$230 annualized cost/annual ton of VOC reduction from current level of control

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[a] This represents emission after control due to RACT and industry changes to print-only (not resulting from RACT), 330 tons of the reduction is credited to print-only change.

Source: Booz, Allen & Hamilton Inc.

BIBLIOGRAPHY

Control of Volatile Organic Emissions from Existing Stationary Sources, EPA-450/2-77-008, May 1977.

Air Pollution Control Engineering and Cost Study of General Surface Coating Industry, Second Interim Report, Springborn Laboratories, Enfield, CT, August 23, 1977

Private conversations at the following companies:

American Can Company, Greenwich, Connecticut
Continental Can Company, Chicago, Illinois
Can Manufacturers Institute, Washington, D.C.
Standard Container Company, Homerville, Georgia

5.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT FOR PLANTS SURFACE COATING PAPER IN THE STATE OF GEORGIA

This chapter presents a detailed analysis of the impact of implementing RACT for plants in the State of Georgia which are engaged in the surface coating of paper. This is meant to include protective or decorative coatings put on paper, pressure-sensitive tapes regardless of substrate, related web coating processes on plastic film and decorative coatings on metal foil, but does not include conventional printing processes which apply inks.

Twelve counties, considered urban nonattainment counties, are included in the statewide analysis including:

- Clayton
- Cobb
- Coweta
- DeKalb
- Douglas
- Fayette
- Fulton
- Gwinnett
- Henry
- Muscogee
- Paulding
- Rockdale.

The chapter is divided into five sections:

- Specific methodology and quality of estimates
- Industry statistics
- The technical situation in the industry
- Cost and VOC reduction benefit evaluations for the most likely RACT alternatives
- Direct economic impacts.

Each section presents detailed data and findings based on analyses of the RACT guidelines; previous studies of paper coating; interviews with paper coaters, coating equipment and materials manufacturers; and a review of pertinent published literature.

5.1 SPECIFIC METHODOLOGY AND QUALITY OF ESTIMATES

This section describes the methodology for determining estimates of:

- Industry statistics
- VOC emissions
- Processes for controlling VOC emissions
- Cost of controlling VOC emissions
- Economic impacts

for plants engaged in the surface coating of paper. The quality of these estimates is discussed in the last part of this section.

5.1.1 Industry Statistics

Paper coating is practiced in a number of industries. Among products that are coated using organic solvents are: adhesive tapes; adhesive labels; decorated, coated and glazed paper; book covers; office copier paper; carbon paper; typewriter ribbons; photographic film; paper cartons; and paper drums. The firms coating paper are classified in a number of groupings in the U.S. Department of Commerce's Standard Industrial Classification system. The major coaters may be found in the following 16 SIC groups:

SIC	Description
2611	Pulp mills
2621	Paper mills, except building paper mills
2631	Paperboard mills
2641	Paper coating and glazing
2643	Bags, except textile bags
2645	Diecut paper and paperboard and cardboard
2649	Paper converting, n.e.c.
2651	Folding paperboard boxes
3291	Abrasive products
3292	Asbestos products
3293	Gaskets, packing and sealing devices
3497	Metal foil and leaf
3679	Electronic components, n.e.c.
3842	Orthopedic, prosthetic and surgical appliances and supplies
3861	Photographic equipment and supplies
3955	Carbon paper and inked ribbons

This list does not include plants listed in the SIC category 2700 (Printing, Publishing and Allied Industries), where paper coating other than printing may also be a part of the overall processing of the printed product.

Statistics concerning these industries were obtained from a number of sources. All data where possible were converted to the base year 1977 for the state using scaling factors developed from U.S. Department of Commerce data as presented in County Business Patterns. The primary sources of economic data were the 1972 Census of Manufactures and 1976 Annual Survey of Manufactures. The Georgia Directory of Manufacturers and industry oriented annuals such as Lockwoods' Directory and Davidson's Blue Book and the Thomas Register of American Manufacturers were used to identify some of the individual companies engaged in paper conversion (i.e., coating of paper in roll form for sale to other manufacturers) and to identify other paper coating firms in the state.

The actual firms expected to be affected by the proposed regulations were identified from this tentative list through a telephone interview with representatives from each facility. Many of the facilities contacted were not paper coaters and also many coated with water-based solvents, exterior or hot melt.

5.1.2 VOC Emissions

As mentioned above, the final list of coating firms with significant VOC emissions in the state was prepared from telephone interviews with the individual firms. These firms either disclosed their actual emissions or provided information from which the emissions could be extrapolated.

5.1.3 Processes for Controlling VOC Emissions

Processes for controlling VOC emissions from sources included in the paper coating category are described in Control of Volatile Organic Emissions from Existing Stationary Sources, Volume II (EPA-450/2-76-028). The feasibility of applying the various control methods to paper coating discussed in this document was reviewed with coating firms, coating suppliers, coating equipment manufacturers and industry associations. These methods include both coating reformulation and the use of control devices, such as incinerators and carbon adsorbers.

Because of the wide variety of coating processes and coating materials in use, most methods of control will find some applicability. The percentage of emissions to be controlled by reformulation and by control devices was estimated based on a review of the literature and on information obtained from the interviews described above.

5.1.4 Cost of Control and Estimated Reduction of VOC Emissions

The overall costs of control of VOC emissions in accord with the proposed regulations were determined from:

- Current emissions
- Type of control to be used
- A development of capital, operating and energy requirements for an average-sized model installation
- Extrapolation of the model plant costs to an industry total based on current emissions.

Model plant costs were primarily based on information provided from:

- Control of Volatile Organic Emissions from Stationary Sources, Volume I (EPA450/276028)
- Air Pollution Control Engineering and Cost Study of General Surface Coating Industry, Second Interim Report, Springborn Laboratories.

Additional cost data was supplied by equipment and material suppliers and published literature sources. Major coaters were consulted to determine industry views on acceptable control methods and, in some cases, to provide direct estimates of their projected control costs and experience in control equipment installations. One coating firm provided a detailed cost estimate for their Georgia plant. The estimated cost was based on actual expenditures for control equipment at another plant they operate in California.

5.1.5 Economic Impacts

The economic impacts were determined by analyzing the lead time requirements to implement RACT, assessing the feasibility of instituting RACT controls in terms of capital and equipment availability, comparing the direct costs of RACT control to various state economic indicators and assessing the secondary effects on market structure, employment and productivity as a result of implementing RACT controls in the state.

5.1.6 Quality of Estimates

Several sources of information were utilized in assessing the emissions, cost and economic impact of implementing RACT controls on the surface coating of paper in Ohio. A rating scheme is presented in this section to indicate the quality of the data available for use in this study. A rating of "A" indicates hard data (data that are published for the base year), "B" indicates data that were extrapolated from hard data and "C" indicates data that were not available in secondary literature and were estimated based on interviews, analysis of previous studies and best engineering judgment. Exhibit 5-1, on the following page, rates each study output listed and the overall quality of the data.

EXHIBIT 5-1
U.S. Environmental Protection Agency
DATA QUALITY--SURFACE COATING OF PAPER

Study Outputs	A Hard Data	B Extrapolated Data	C Estimated Data
Industry statistics		X	
Emissions		X	
Cost of emissions control		X	
Economic impact		X	
Overall quality of data		X	

Source: Booz, Allen & Hamilton Inc.

5.2 INDUSTRY STATISTICS

Industry characteristics, statistics and trends for paper coating in Georgia are presented in this section. This information forms the basis for assessing the total impact of implementing RACT for control of VOC emissions in the state and for the effect upon individual firms.

5.2.1 Size of the Industry

The 1977 Georgia Directory of Manufacturers and Lockwoods' Directory report a total of about 106 firms in 16 SIC categories in Georgia where paper coating, as defined in proposed RACT guidelines, is the main business of the firm or may be a part of its manufacturing activity. The number of firms and other relevant statistics in each SIC grouping are summarized in Exhibit 5-2, on the following page.

Total value of shipments for these firms is estimated to be about $1.9 billion, with a total of about 19,000 employees. New capital expenditures are estimated to be about $216 million annually, based on the most recent (1976) Annual Survey of Manufactures.

Of the total 106 firms in Georgia in the 16 SIC categories, there are nine which will be impacted by the proposed paper coating regulations. Of these nine, only three, Dymo Industrial Marketing Systems, Colonial Packaging and Mead Packaging Corporation are expected to suffer a major economic impact. Seven of the coating firms use solventless systems (waterbased materials, extrusion or hot melt techniques) and will suffer only minor economic impact. Based on the statistics given in Exhibit 5-2, the total annual value of shipments of the two most heavily impacted firms is estimated at approximately $25 million. The three firms employ about 300 people.

5.2.2 Comparison of the Industry to the State Economy

A comparison of the value of shipments of plants in the SIC categories listed above with the state economy indicates that these plants represent about 3.7 percent of the total value of manufacturing shipments in Georgia. The industry employs 2.6 percent of all manufacturing employees in the state.

EXHIBIT 5-2
U.S. Environmental Protection Agency
1976 INDUSTRY STATISTICS--SURFACE COATING OF PAPER SIC GROUPS IN GEORGIA

SIC Code	Description	Number of Plants	Total Number of Employees	Total Payroll ($1,000)	Estimated Value of Shipments[a] ($1,000,000)	Estimated New Expenditures[a] ($1,000)
2611	Pulp mills	7	2,139	23,000	280.0	51,100
2621	Paper mills, except building paper mills	2	396	4,260	36.6	3,240
2631	Paperboard mills	10	8,057	133,600	1,101	148,600
2641	Paper coating and glazing	10	384	4,140	30.0	899
2643	Bags, except textile bags	13	2,846	31,600	189.8	5,270
2645	Diecut paper and paperborad and cardboard	10	282	2,600	18.9	527
2649	Paper converting, n.e.c.	7	2,029	20,600	114.6	2,250
2651	Folding paperboard boxes	16	1,000	13,500	55.0	1,610
3291	Abrasive products	1	50	539	2.90	90.5
3292	Asbestos products	3	167	923	9.94	202
3293	Gaskets, packing and sealing devices	3	33	355	1.22	42.9
3497	Metal foil and leaf[b]	-	-	-	-	-
3679	Electronic components, n.e.c.	5	50	443	2.10	86.0
3842	Orthopedic, prosthetic and surgical appliances and supplies	13	852	7,440	36.1	1,230
3861	Photographic equipment and supplies	3	51	549	4.20	165
3955	Carbon paper and inked ribbons	3	537	7,700	40.5	730
Total		106	18,873	243,500	1893.3	216,000

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a. Estimated by using ratios of (value of shipment/total employment) and (capital expenditures/total employment) for each SIC group as published in 1976 Annual Survey of Manufactures where value of shipments or expenditures are not tabulated for the state.

b. None listed.

Source: Booz, Allen & Hamilton Inc.: 1976 County Business Patterns, and 1976 Annual Survey of Manufactures, U.S. Department of Commerce and the 1977 Georgia Directory of Manufactures.

5.2.3 Historical and Future Patterns of the Industry

The nationwide value of shipments in the industries expected to be affected by the proposed paper coating regulations, in general, exceed the growth rate of the economy. As summarized in Exhibit 5-3, on the following page, the value of shipments increased in every category between 1972 and 1976, with an average annual growth rate of about 12.1 percent over the period. Compared to an average inflationary rate of 6 to 8 percent, this is equivalent to a real growth rate of 4 to 6 percent. In some individual categories, growth rates were even greater. Paper production increased by an uncorrected average annual growth rate of 16.5 percent; metal and foil by 16 percent; paper coating and glazing by about 12 percent, only slightly less than the average.

It is expected that the growth rate will increase at these rates for the near future.

EXHIBIT 5-3
U.S. Environmental Protection Agency
HISTORICAL TRENDS IN VALUE OF SHIPMENTS OF U.S. PLANTS ENGAGED IN PAPER COATING ($ millions)

SIC Code	1972	1973	1974	1975	1976
2611	710	849	1,525	1,630	2,055
2621	6,385	7,514	9,942	9,650	11,768
2631	4,153	4,862	6,516	6,055	6,724
2641	1,954	2,284	2,645	2,626	3,074
2643	1,886	2,183	2,867	2,980	3,379
2645	676	747	923	943	1,027
2649	631	833	1,079	1,090	1,288
2651	1,487	1,644	1,890	1,952	2,223
3291	888	1,067	1,235	1,222	1,433
3292	763	823	963	900	988
3293	665	723	835	843	1,020
3499	702	753	973	1,065	1,267
3679	3,060	3,430	3,210	3,450	4,120
3842	1,450	1,620	1,800	2,090	2,240
3861	5,624	6,435	7,490	7,627	8,844
3955	237	268	309	285	294
Total	31,271	36,035	42,400	44,408	51,744

Source: 1976 Annual Survey of Manufactures, U.S. Department of Commerce.

5-7-a

5.3 TECHNICAL SITUATION IN THE INDUSTRY

This section briefly describes the general process and materials used in the surface coating of paper and similar products proposed to be included under the RACT Surface Coating of Paper regulations. The technology is fully described in the RACT documents. The products include a myriad of consumer and industry oriented items, such as pressure-sensitive tapes, adhesive labels, book covers, milk cartons, flexible packaging materials and photographic film. Although many of these products are also printed in one manner or another, the emissions from printing inks are not included in the RACT regulations pertaining to paper coating; only the emissions specifically issuing from the coating operation are included. An estimate of these emissions for the state is also presented in this section.

5.3.1 General Coating Process Description

In organic solvent paper coating, resins are dissolved in an organic solvent mixture and this solution is applied to a web (continuous roll) of paper. As the coated web is dried, the solvent evaporates and the coating cures.

Most organic solvent-borne coating is done by paper converting companies that buy paper from the mills and apply coatings to produce a final product. The paper mills themselves sometimes apply coatings, but these are usually waterborne coatings consisting of a pigment (such as clay) and a binder (such as starch or casein). However, much additional coating is done by firms only as part of the manufacturing process.

Solvent emissions from an individual coating facility will vary with the size and number of coating lines. A plant may have one or as many as 20 coating lines. Uncontrolled emissions from a single line may vary from 50 pounds per hour to 1,000 pounds per hour, depending on the line size. The amount of solvent emitted also depends on the number of hours the line operates each day.

Exhibit 5-4 gives typical emission data from various paper coating applications.

EXHIBIT 5-4

U.S. Environmental Protection Agency

EMISSION DATA FROM TYPICAL PAPER COATING PLANTS

Number of coating lines	Solvent Usage (lb./day)	Solvent Emissions (lb.day)	Control Efficiency (%)a	Control Device
2	10,000	10,000	-	None
5	15,000	15,000	-	None
8	9,000	9,000	-	None
2	1,200	1,200	-	None
10	24,000	950	96	Carbon adsorption
20	55,000	41,000	90	Carbon adsorption (not all lines controlled)
3	5,000	1,500	90	Carbon adsorption
3	21,000	840	96	Carbon adsorption
1	10,500	500	96	Afterburner

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a. Neglecting emissions that are not captured in the hooding system.

Source: Control of Volatile Organics from Stationary Sources, EPA-450/2-76-028.

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5.3.2 Nature of Coating Materials Used

The formulations usually used in organic solvent-borne paper coatings may be divided into the following classes: film-forming materials, plasticizers, pigments and solvents. Dozens of organic solvents are used. The major ones are: toluene, xylene, methyl ethyl ketone, isopropyl alcohol, methanol, acetone and ethanol.

Although a single solvent is frequently used, often a solvent mixture is necessary to obtain the optimum drying rate. Too rapid drying results in bubbles and an "orange peel" effect in the coating; whereas, slow drying coatings require more time in the ovens or slower production rates. Variations in the solvent mixture also affect the solvent qualities of the mix.

The main classes of film formers used in conventional paper coating are cellulose derivatives and vinyl resins. The most commonly used cellulose derivative, nitrocellulose has been used for paper coating decorative paper, book covers and similar items since the 1920s. It is relatively easy to formulate and handle, and it dries quickly, allowing lower oven temperatures than vinyl coatings. The most common vinyl resin is the copolymer of vinyl chloride and vinyl acetate. These vinyl copolymers are superior to nitrocellulose in toughness, flexibility and abrasion resistance. They also show good resistance to acids, alkyds, alcohols and greases. Vinyl coatings tend to retain solvent, however, so that comparatively high temperatures are needed. In general, nitrocellulose is most applicable to the decorative paper field, whereas vinyl copolymers are used for functional papers, such as some packaging materials.

In the production of pressure-sensitive tapes and labels, adhesives and silicone release agents are applied using an organic solvent carrier. The adhesive layer is usually natural or synthetic rubber, acrylic or silicone. Because of their low cost, natural and synthetic rubber compounds are the main film formers used for adhesives in pressure-sensitive tapes and labels, although acrylic and silicone adhesives offer performance advantages for certain applications. In most cases tapes and labels also involve the use of release agents applied to a label carrier or the backside of tape to allow release. The agents are usually silicone compounds applied in a dilute solvent solution.

5.3.3 Current VOC Emissions

Current emissions from paper coating in Georgia are approximately 1370 tons per year. These emissions are from paper coaters not meeting the proposed regulations. Total emissions are somewhat higher. These data were gathered through an exhaustive telephone survey of companies expected to be affected by the regulations.

A summary of potentially impacted firms and their emissions is presented in Exhibit 5-5.

5.3.4 RACT Guidelines

The RACT guidelines for control of VOC emissions from the surface coating of paper require that emission discharges of VOCs be limited to 2.9 pounds per gallon of coating material delivered to the coating applicator.

The recommended methods of achieving this requirement are:

- The application of low solvent content coatings; or
- Incineration, provided that 90 percent of the nonmethane VOCs (measured as combustible carbon) which enter the incinerator are oxidized to carbon dioxide and water; or
- A system demonstrated to have control efficiency equivalent to or greater than provided by either of the above methods.

In the following section are discussed several methods of low solvent and solventless systems, which have been demonstrated to be applicable to some paper coating products, and the two principal add-on systems, incineration and carbon adsorption, generally used for emission control. This information has been extracted principally from the previously cited EPA report, Control of Volatile Organic Emissions from Existing Sources, Volume II, which should be consulted for a more thorough discussion. In some instances, additional comment was obtained from coaters, coating material suppliers and control equipment manufacturers.

Exhibit 5-5

U.S. Environmental Protection Agency

COMPANY ESTIMATES OF PAPER COATING EMISSIONS
AS REPORTED TO BOOZ, ALLEN AND HAMILTON

Company Name, Location	SIC Code	Employees	Total Reported Emissions (tons/year)	Emissions Applicable Under Paper Coating Category (tons/year)
American Can Company St. Marys	2641	a	0[c]	0
American Tara Corp. Chamblee	3955	47	0[d]	0
Colonial Packaging Chamblee	2641 2631	32	10	10
Dymo Industrial Marketing Systems, Atlanta	2641	88	51	51
Fasson, Division of Avery Intl., Peachtree City	2641	85	0[b]	0
Frye Copy Systems Decatur	3955	46	0[b]	0
Mead Packaging Atlanta	2641	175	1,300	1,300
National Emperial Label Systems, Stone Mountain	2641	55	0[b]	0
Paper Products Inc. Augusta	2641 2649	26	~50	0
Technicarbon Conyers	3955	24	0[d]	0
		578	1,411	1,361

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a. Not reported
b. Uses waterbased materials
c. Uses an extrusion process
d. Uses a hot melt process

Source: Booz, Allen & Hamilton Inc.

5.3.5 Low Solvent and Solventless Coatings

In Exhibit 5-6, on the following page, are listed several types of coating materials, which have found utility in paper coating, and an estimate of expected solvent reduction.

5.3.5.1 Waterborne Coatings

Waterborne coatings have long been used in coating paper to improve printability and gloss. However, newer coatings have been developed in which a synthetic insoluble polymer is carried in water as a colloidal dispersion or an emulsion. This is a two-phase system in which water is the continuous phase and the polymer resin is the dispersed phase. When the water is evaporated and the coating cured, the polymer forms a film that has properties similar to those obtained from organic-solvent-based coatings.

5.3.5.2 Plastisols and Organisols

Plastisols are a colloidal dispersion of synthetic resin in a plasticizer. When the plasticizer is heated, the resin particles are solvated by the plasticizer so that they fuse together to form a continuous film. Plastisols usually contain little or no solvent, but sometimes the addition of a filler or pigment will change the viscosity so that organic solvents must be added to obtain desirable flow characteristics. When the volatile content of a plastisol exceeds 5 percent of the total weight, it is referred to as an organisol.

Although organic solvents are not evaporated from plastisols, some of the plasticizer may volatilize in the oven. This plasticizer will condense when emitted from the exhaust stack to form a visible emission.

5.3.5.3 Hot Melt Coatings

Hot melt coatings contain no solvent; the polymer resins are applied in a molten state to the paper surfaces. All the materials deposited on the paper remain as part of the coating. Because the hot melt cools to a solid coating soon after it is applied, a drying oven is not needed to evaporate solvent or to cure the coating. Energy that would have been used to heat an oven and to heat makeup air to replace oven exhaust is therefore saved.

EXHIBIT 5-6

U.S. Environmental Protection Agency
ACHIEVABLE SOLVENT REDUCTIONS USING LOW SOLVENT COATINGS IN PAPER COATING INDUSTRY

Type of Low Solvent-Coating	Reduction Achievable (%)[a]
Waterborne coatings	80-99
Plastisols	95-99
Hot melts	99+
Extrusion coatings	99+
Pressure-sensitive adhesives	
Waterborne	80-99
Hot melts	99
Prepolymer	99
Silicone release agents	
100 percent nonvolatile coatings	99+
Waterborne emulsions	80-99

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[a] Based on comparison with a conventional coating containing 35 percent solids by volume and 65 percent organic solvent by volume.

Source: EPA 450/2-76-028, op. cit.

One disadvantage with hot melt coatings is that materials that char or burn when heated cannot be applied by hot melt. Other materials will slowly degrade when they are held at the necessary elevated temperatures.

5.3.5.4 Extrusion Coatings

A type of hot melt coating, plastic extrusion coating is a solventless system in which a molten thermoplastic sheet is discharged from a slotted dye onto a substrate of paper, paperboard or synthetic material. The moving substrate and molten plastic are combined in a nip between a rubber roll and a chill roll. A screw-type extruder extrudes the coating at a temperature sometimes as high as 600°F. Low and medium density polyethylene are used for extrusion coating more than any other types of resins.

5.3.5.5 Pressure-Sensitive Adhesive Coatings

Waterborne adhesives have the advantage that they can be applied with conventional coating equipment. Waterborne emulsions, which can be applied less expensively than can solvent-borne rubber-based adhesives, are already in use for pressure-sensitive labels. A problem with waterborne adhesives is that they tend to cause the paper substrate to curl and wrinkle.

Prepolymer adhesive coatings are applied as a liquid composed of monomers containing no solvent. The monomers are polymerized by either heat or radiation. These prepolymer systems show promise, but they are presently in a developmental stage only.

5.3.5.6 Silicone Release Coatings

Silicone release coatings, usually solvent-borne, are sometimes used for pressure-sensitive, adhesive-coated products. Two low-solvent alternatives are currently on the market. The first is a 100 percent nonvolatile coating which is usually heatcured, but may be radiation cured. The second system is water emulsion coatings which is lower in cost than the prepolymer coating. However, because of wrinkling and other application problems the waterborne coating may be of limited value.

Some silicone coating materials which are under development use single solvent systems that can be readily recovered by carbon adsorption. Current coatings are troublesome since some silicone is carried into the adsorber where it clogs the carbon pores to reduce adsorption efficiency.

5.3.6 Incineration

Catalytic and direct thermal incineration processes convert hydrocarbons to carbon dioxide and water at high temperatures. Incineration is widely accepted as a reliable means of reducing hydrocarbon emissions by 90 percent or more.

Generally, the major disadvantage of this approach is the increased energy required to raise the exhaust gas temperatures above 1,200°F for direct incineration and 700°F for catalytic incineration. Another problem is the generation of nitrogen oxides in direct fired incinerators because of the exposure of air to high-temperature flames.

The increased energy consumption can, in some cases, be reduced or eliminated by heat exchange of the exhaust gases with fresh emissions (primary heat recovery) or by use of the hot incinerator exhaust gases in process applications (secondary heat recovery). Typical use of secondary heat recovery is for oven heat in drying or baking ovens. In fact, with efficient primary exchange and secondary heat recovery, total fuel consumption of an incinerator-oven system can be less than that for the oven before the incinerator is added. The heat required to sustain the system comes from the combustion of the volatile organic compounds in the exhausts.

Paper coaters who use coating machinery for a multiplicity of processes have commented that catalytic incineration would probably not be used because of the possibility of catalyst poisoning. Direct incineration would be used.

5.3.7 Carbon Adsorption

Carbon adsorption has been used since the 1930s for collecting solvents emitted from paper coating operations. Most operational systems on paper coating lines were installed because they were profitable. Pollution control has usually been a minor concern.

Carbon adsorption is most adaptable to single solvent processes. Many coaters using carbon adsorption have reformulated their coatings so that only one solvent is required. Toluene, a widely used solvent for paper coating, is readily captured in carbon adsorption systems.

The greatest obstacle to the economical use of carbon adsorption is that, in some cases, reusing recovered solvents may be difficult. In many coating formulations, a mixture of several solvents is needed to attain the desired solvency and evaporation rates. Also if different coating lines within the plant use different solvents and are all ducted to one carbon adsorption system, then there may be difficulty reusing the collected solvent mixture. In some cases, such as in the preparation of photographic films or thermographic recording paper, extremely high purity solvents are necessary to maintain product performance and even distillation may be insufficient to produce the quality of recovered solvent needed. For most other coating formulations, distillation is adequate.

Another problem with carbon adsorption is the potential of generating explosive conditions in the adsorber because of the localized increases in combustible organic material concentrations. Ignition apparently can be caused by static electricity in systems where dry air at high flow rates is treated. Several explosions of absorbers have been reported in paper coating and other plants.

Also, adsorption of solvents containing water soluble compounds (such as alcohols, ketones or esters) can present a secondary pollution problem where steam is used for regeneration. Additional treatment of the condensed steam with its content of dissolved organics would be required, increasing the complexity of the solvent recovery system and its cost.

5.4 COST AND VOC REDUCTION BENEFIT EVALUATIONS FOR THE MOST LIKELY RACT ALTERNATIVES

This section discusses the projected costs of control for paper coating in the state.

Where possible, several coaters in Georgia have already switched to water-based or solventless systems. Three are using water-based coatings, two are using hot melt systems, and one is using an extruded coating. Of the firms using the current high solvent coatings, Mead Packaging will probably use incineration with primary heat recovery and Dymo and Colonial will consider using carbon adsorption to comply with the proposed regulations.

Mead Packaging provided the costs associated with installation and operation of the incineration system. The cost of the carbon adsorption system is derived from information presented in the following section.

5.4.1 Costs of Alternative Control Systems

Exhibit 5-7, on the following page, presents costs for a typical carbon adsorption system as developed by EPA sources. The system is based on the assumption that exhaust air flow rates can be reduced sufficiently to attain LEL levels of 25 percent. This is possible with well-designed ovens where excess air can be reduced or where product characteristics allow.

Several paper coaters indicate that this may not be possible with older coating lines or with certain types of coating. Coating drying rate is a function of air flow rate, temperature and vapor concentration in the air. If air flow rates are to be reduced, drying temperatures or drying times must be increased. Because of the heat sensitivity of some coating, temperature increases may not be possible. Increase in drying time will necessitate either more time in the ovens or reduced production rates. Several coaters of heat sensitive products indicated that in order to achieve special characteristics they could not increase emission concentrations above 5 to 6 percent of LEL and could not use oven temperatures above 140°F. Plants manufacturing conventional coated products, however, can decrease air flow rates sufficiently to increase VOC concentrations in the exhausts to 40-50 percent with only moderate increases in temperatures or changes in production rates. We have assumed for cost estimation purposes that a 25 percent LEL can be attained on the average.

EXHIBIT 5-7
U.S. Environmental Protection Agency
CARBON ADSORPTION COSTS FOR PAPER COATING INDUSTRY

	Installed Cost ($)	Annualized Cost ($/yr.)	Control Cost ($ ton of solvent recovered)
No credit for recovered solvent	320,000	127,000	125
Recovered solvent credited at fuel value	320,000	60,000	40
Solvent credited at market	320,000	(100,000)[a]	(50)[a]

Note: Operating parameters are: process rate of 15,000 scfm, temperature of 170°F, operation at 25 percent of LEL. See Volume I, Chapter 4, for details on cost estimates. Costs are believed to be valid only for mid-1974.

a. Costs in parenthesis indicate a net gain.

Source: EPA-450/2-76-028

Both incinerator costs and adsorber costs are a function of equipment size and vary generally with air flow rate. It was assumed for projection of overall costs in the state that control equipment, on the average, would be sized for 15,000 scfm per unit. In most plants, it is impractical to manifold exhausts so that all exhausts could be treated in one add-on emission control system. In the case of incinerators, it would be difficult to use secondary heat recovery on ovens where the incinerator is remote from the oven.

The major problem in estimating total installed costs of control systems is the added cost of installation. This problem is inherent in any generalized rather than specific cost estimating procedure. The EPA estimates were made on the assumption of an easily retrofitted system. In practice some coaters have found actual installed costs to be three to five times those summarized in Exhibit 5-7. However, in the state of Georgia, these figures were used for only one facility; and provide a generalized rather than a specific cost estimate.

5.4.2 Estimated Statewide Costs

The total emissions considered to be applicable under RACT, as discussed in Section 5.3.4 of this report, are approximately 1370 tons per year. Based on this emission rate and EPA costs, as summarized in Exhibit 5-6, capital costs are estimated as $6.0 million to $1.4 million per year. All bases and assumptions used in this estimate are summarized in Exhibit 5-8, on the following page. The costs presented in Exhibit 5-7 were increased by 25 percent to account for inflationary increases from mid-1974 to mid-1977.

Because most plants will have difficulty in retrofitting add-on control systems, based on the information in EPA 450/276028, capital costs are considered to be low and were increased by a factor of three to four.

5.4.3. Estimated Emission Reduction

Assuming that 90 percent of all solvents used in coating operations can be collected by properly designed hoods and ovens, emissions could be reduced by approximately 1,000 tons per year. This is based on a 90 percent capture of emissions by a carbon adsorber or destruction in an incinerator, an overall reduction in emissions of 81 percent.

EXHIBIT 5-8
U.S. Environmental Protection Agency
SUMMARY OF ASSUMPTIONS USED IN
ESTIMATING COST OF CARBON ADSORPTION SYSTEM

Assumptions

Carbon adsorption with recovered solvent credited at fuel prices

25 percent LEL is equal to 3,000 ppm of toluene by volume

Air flow can be reduced to reach 25 percent LEL

The price of a 15,000 SCFM system can be used as an average. No costs are added for distillation or additional waste disposal.

33,500 tons of emissions are treated per year over an operating period of 5,840 hours per year.

Other assumptions regarding incinerator and adsorber prices, as estimated in Control of Volatile Organic Emissions from Existing Stationary Sources, Vol. I: Control Methods for Surface-Coating Operations, EPA-450/2-76-028, are valid.

Source: Booz, Allen & Hamilton Inc.

5.5 DIRECT ECONOMIC IMPACTS

This section presents the direct economic implications of implementing the RACT guidelines for surface coating of paper on a statewide basis. The analysis includes the availability of equipment and capital; feasibility of the control technology; and impact on economic indicators, such as value of shipments, unit price (assuming full cost pass-through), state economic variables and capital investment.

5.5.1 RACT Timing

Current proposed guidelines for paper coating suggest several compliance deadlines for alternative methods of compliance.[1] Generally, for add-on systems they call for installation of equipment and demonstration by mid-1980 or late 1980; for low solvent systems, by late 1980 or mid-1981, depending upon the degree of research and development needed. Major coaters, material suppliers and equipment manufacturers believe these deadlines to be unattainable.

- Normally, large incinerator and carbon adsorption systems will require about a year or more from receipt of purchase to install and start up the system. Engineering may require three months or more, fabrication three to six months and installation and startup as long as three months.
- Only a small number of companies manufacture incineration systems with proven high heat recovery. The cumulative effect of equipment requirements by all firms in the U.S. needing control devices could severely impede the ability of these firms to supply equipment. In some cases, the most efficient devices are only now undergoing initial trials, and no production capacity has been developed.

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[1] Regulatory Guidance for Control of Volatile Organic Compound Emissions from 15 Categories of Stationary Sources, EPA-905/2-78-001

In general, it appears that if add-on control systems are used deadlines must be extended.

5.5.2 Technical Feasibility Issues

Though low solvent or solventless materials are used in many paper coating operations at present, many types of solvent-based systems have no satisfactory replacement. The alternative materials do not meet the product quality standards demanded by the coaters. Additional development is needed and will require the combined efforts of both the coaters (who must maintain product quality) and the coating material suppliers. Ideally, the new coating materials should be adaptable to existing coating equipment to minimize additional capital investment.

As discussed above, both incineration and carbon adsorption are not completely satisfactory add-on control systems. Incineration requires large volumes of additional fuel if good heat recovery is not accomplished; carbon adsorption is not usable on many coating systems because of the multiplicity of compounds used in solvent mixtures.

5.5.3 Comparison of Direct Cost with Selected Direct Economic Indicators

The net increase in annual operating costs to coaters was estimated at $385,000 to $505,000. Based on similar economic impact studies, these additional costs are projected to represent 1.5 percent to 2.0 percent of the total annual value of shipments of the firms affected by the proposed regulations. Assuming a "direct pass-through" of these costs, prices will increase by about the same fraction.

The major economic impact in terms of cost to most individual companies will be the large capital expenditures required for add-on devices, rather than increased annual operating costs. For most companies, these costs would exceed their current level of capital expenditures for plant improvement and expansion. A large pressure-sensitive paper coater in another state, for instance, has estimated that a capital investment of about $2 million would be needed to meet proposed guidelines. His current capital expenditure program is normally in the range of $1.5 million.

5.5.4 Selected Secondary Economic Impacts

This section discusses the secondary impact of implementing RACT on employment, market structure and productivity.

Employment is not expected to be affected. Employment would be reduced if marginally profitable facilities closed, but the present indication from the industry is that plant closures will not occur.

No significant effect on overall productivity is foreseen except for a small change resulting from the need for add-on control system operating and maintenance personnel.

* * * *

Exhibit 5-9, on the following page, summarizes the conclusions reached in this study and the implications of the estimated costs of compliance for paper coaters.

EXHIBIT 5-9

U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR PAPER COATERS IN THE STATE OF GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	Three plants in Georgia are expected to suffer major impact under these regulations. However, if this category is interpreted to include all types of paper coating, including publishing, far more firms would be affected
Indication of relative importance	The 1977 value of shipments of these is estimated to be $25 million. These plants are estimated to employ 300 employees
Current industry technology trends	Gravure coating replacing older systems
1977 VOC emissions (actual)	Approximately 1,411 tons per year were identified from the emission inventory
Industry preferred method of VOC control to meet RACT guidelines	Use of solventless systems is increasing and several plants in Georgia have converted to them
Assumed method of control to meet RACT guidelines	Thermal incineration with primary heat recovery and carbon adsorption

Affected Areas in Meeting RACT	Discussion
Capital investment (statewide)	Estimated to be 3.4 million to 4.1 million depending on retrofit situations. This is likely to be more than 100 percent of normal expenditures for the affected paper coaters
Annualized cost (statewide)	$385,000 to $505,000 annually. This may represent 1.5 to 2.0 percent of the 1977 annual sales for the affected paper coaters
Price	Assuming a "direct cost pass-through"--1.5 to 2.0 percent
Energy	Assuming 70 percent heat recovery annual energy requirements are expected to increase by approximately 7,000 equivalent barrels of oil annually
Productivity	No major impact

EXHIBIT 5-9 (2)
U.S. Environmental Protection Agency

Affected Areas in Meeting RACT	Discussion
Employment	No major impact
Market structure	No major impact
RACT timing requirements (1982)	RACT guideline needs clear definition for rule making
	Nationwide equipment deliverables and installation of incineration systems prior to 1982 are expected to present problems
Problem areas	Retrofit situations and installation costs are highly variable
	Type and cost of control depend on particular solvent systems used and reduction in air flow
VOC emissions after control	270 tons/year (20 percent of 1977 VOC emission level)
Cost effectiveness of control	\$350-\$460 annualized cost/annual ton of VOC reduction

Source: Booz, Allen & Hamilton Inc.

BIBLIOGRAPHY

T.W., Hughes, et. al., Source Assessment: Prioritization of Air Pollution from Industrial Surface Coating Operations, Monsanto Research Corporation, Dayton, Ohio. Prepared for U.S. Environmental Protection Agency, Research Triangle Park, N.C., under Contract No. 68-02-1320 (Tech. 14) Publication No. 650/2-75-019a.

T. A. Kittleman and A. B. Akell, "The Cost of Controlling Organic Emissions," Chemical Engineering Progress, April 1978.

Springborn Laboratories, Air Pollution Control Engineering and Cost Study of General Surface Coating Industry, Second Interim Report. EPA Contract No. 68-0202075, August 23, 1977.

Davidson's Textile Blue Book, 1977.

Lockwood's Directory of the Paper Industry, 1977.

Thomas Register of American Manufacturers, 1978.

U.S. Environmental Protection Agency, Control of Volatile Organic Emissions from Existing Stationary Sources, Volume I. EPA-450/2-76-028, May 1977.

U.S. Environmental Protection Agency, Control of Volatile Organic Emissions from Existing Stationary Sources, Volume II. EPA-450/2-77-028, May 1977.

U.S. Environmental Protection Agency, Regulatory Guidance for Control of Volatile Organic Compounds Emissions from 15 Categories of Stationary Sources, EPA-950/2-78-001, April 1978.

U.S. Department of Commerce, Annual Survey of Manufactures, 1976.

U.S. Department of Commerce, County Business Patterns, 1976.

U.S. Department of Commerce, Census of Manufactures, 1972.

Private conversations with:

American Can Company, St. Mary's, Georgia
American Tara Company, Chamblee, Georgia
Colonial Packaging Company, Chamblee, Georgia
Dymo Industrial Marketing Systems, Atlanta, Georgia
Fasson Industries, Peachtree City, Georgia
Frye Copy Systems, Decatur, Georgia

Mead Packaging, Atlanta, Georgia
Paper Products Inc., Augusta, Georgia
Technicarbon, Conyers, Georgia

5-19-d

6.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT FOR PLANTS SURFACE COATING FABRICS IN THE STATE OF GEORGIA

The purpose of this chapter is to present an analysis of the impact of implementing RACT for plants in the State of Georgia which are engaged in the surface coating of fabrics and vinyls. However, a survey of the fabric and vinyl coating industry in Georgia by Booz, Allen did not identify any facilities that are likely to be affected by the proposed RACT guidelines in Georgia. Thus, the proposed RACT guidelines for fabric and vinyl coating would not have an economic impact on the industry in Georgia. This chapter, therefore, presents the methodology used in identifying potentially affected firms by the RACT guidelines in Georgia and the results of its application. The chapter is organized into two sections.

- Scope of Proposed Regulations
- Facilities Potentially Affected by the Proposed Regulations.

6.1 SCOPE OF THE PROPOSED REGULATIONS

The proposed Georgia regulations for controlling VOC emissions from existing fabric coating plants apply to the roll, knife or rotogravure coating and oven drying of textile fabrics (to impart strength, stability, appearance, or other properties), or of vinyl coated fabrics or vinyl sheets. It applies to printing on vinyl coated fabrics or vinyl sheets to modify appearance but not to printing on textile fabrics for decorative or other purposes. It also does not apply to the coating of fabric substrates with vinyl plastic polymers which are usually applied to melts or plastisols that result in only minor amounts of emissions.

The proposed regulations apply statewide to plants emitting over 100 tons/year of VOC. However, for the 12 non-attainment counties in the state, plants emitting over five pounds per hour or 50 pounds per day are also subject to the regulations.

6.2 FACILITIES POTENTIALLY AFFECTED BY THE PROPOSED REGULATIONS

The coating of fabrics is used to produce a large variety of common consumer and industrial products. Typical products are raincoats, upholstery, wall covering, tablecloths, window shades, gasketing, diaphragms, lifeboats and bookcovers, In most cases the finished product is manufacturerd by firms who purchase the coated fabric from a manufacturer whose principal activity is fabric coating. However, there are a number of vertically integrated firms (the major automobile manufacturers are typical) which both coat fabrics and manufacture finished goods for them. Other exceptions are firms which both manufacture fabrics and coat them. Thus firms which coat fabrics or vinyl coated fabrics or sheeting can be found in a number of Standard Industrial Classification categories; these are listed below:

SIC	Description
2211	Broad woven fabric mills, cotton
2221	Broad woven fabric mills, man-made and silk
2241	Narrow fabrics and other, small wares mills
2258	Warp knit fabric mills
2261	Finishers of broad woven fabrics of cotton
2262	Finishers of broad woven fabrics of man-made fiber and silk
2269	Finishers of textiles, n.e.c.*
2295	Coated fabrics, not rubberized
2297	Nonwoven fabrics
3069	Fabricated rubber products, n.e.c.*
3079	Miscellaneous plastics products
3291	Abrasive products
3293	Caskets, packing, sealing devices

A list of 41 establishments expected to be affected by the proposed fabric coating RACT regulations in the state was compiled from the review of the following industry directories:

- Davidson's Textile Blue Book
- Rubber Red Book
- Modern Plastic Encyclopedia
- Thomas Register of American Manufacturers
- Georgia Directory of Manufacturers
- Membership list of the Canvas Products Association.

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* Not elsewhere classified

The state officials and the Booz, Allen study team interviewed the firms by telephone to determine whether those firms were involved in surface coating of fabric or not and what their emissions or solvent usage were.

As a result of this telephone survey, 33 firms were eliminated from the original list of potentially affected firms because they either do not coat fabrics or are no longer in business.

Of the remaining 8 firms, 5 are involved in coating carpet backs with latex, which does not contain organic solvents.

The remaining 3 firms included Goodyear Tire Company of Rockmart, Pandel Chemicals of Cartersville and Champion Package Company of Columbus. Goodyear coats tire fabric with latex which does not contain organic solvent, but some of the polymers contained in the tire fabric vaporize during drying. However, the principal concern in this case is the control of particulates emissions, with no appreciable VOC emissions. Of the remaining 2 fabric coaters, Pandel Chemical Company uses spray coating method for coating urethane on carpet backs, whereas Champion Package Company uses an extrusion coating method for coating paper with polyethylene. Since spray and extrusion coating methods are not subject to the RACT guidelines, these firms are not affected by the regulations.

In summary, none of the fabric coating facilities in Georgia would be affected by the proposed Georgia regulation for VOC control. Thus, there would be no economic impact of implementing the proposed regulations for fabric coating in Georgia.

BIBLIOGRAPHY

Davidson's Textile Blue Book, 1977.

T.W. Hughes, et al., *Source Assessment: Prioritization of Air Pollution from Industrial Surface Coating Operations*, Monsanto Research Corporation, Dayton, Ohio. Prepared for U.S. Environmental Protection Agency, Research Triangle Park, N.C., under Contract No. 68-02-1320 (Tech. 14) Publication No. 650/2-75-019a.

T.A. Kittleman and A.B. Akell, "The Cost of Controlling Organic Emissions," *Chemical Engineering Progress*, April 1978.

Springborn Laboratories, *Air Pollution Control Engineering and Cost Study of General Surface Coating Industry, Second Interim Report*, EPA Contract No. 68-02-2075, August 23, 1977.

Textile Economics Bureau, *Technicon*, November 1977, State Industrial Directories Corporation, South Carolina State Development Board, Planning and Research Division, *Industrial Directory of South Carolina*, 1978.

Thomas Register of American Manufacturers, 1978.

U.S. Department of Commerce, *County Business Patterns*.

U.S. Department of Commerce, *Annual Survey of Manufactures, 1976*, *Industry Profiles*, M76 (AS)-7.

U.S. Department of Commerce, *Annual Survey of Manufactures, 1976*, *Value of Product Shipments*, M76 (AS)-2.

U.S. Environmental Protection Agency, *Control of Volatile Organic Emissions from Existing Stationary Sources, Volume I*, EPA-450/2-77-009, May 1977.

U.S. Environmental Protection Agency, *Control of Volatile Organic Emissions from Existing Stationary Sources, Volume II*, EPA-450/2-77-008, May 1977.

U.S. Environmental Protection Agency, *Regulatory Guidance for Control of Volatile Organic Compounds Emissions from 15 Categories of Stationary Sources*, EPA-950/2-78-001, April 1978.

Interviews with:

Goodyear Tire Company, Rockmount, Georgia
Pandel Chemicals Cartersville, Georgia
Champion Package Company, Columbus, Georgia

7.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT FOR THE SURFACE COATING OF AUTOMOBILES IN THE STATE OF GEORGIA

This chapter presents a detailed analysis of the impact of implementing RACT for surface coating of automobiles in the State of Georgia.

The capital cost and energy requirements to achieve the recommended RACT limitations were anticipated to be higher than for any other industrial category studied. In addition, the EPA is currently considering modifying the limitations in certain areas. Therefore, the economic impact and analysis for surface coating of automobiles is presented in two scenarios of RACT implementation:

- RACT compliance by 1982
- Modified RACT timing requirements and possibly limitations to meet developing technologies.

To the extent that light duty trucks are also manufactured in the same automobile assembly plant, their impact is included. The chapter is divided into six sections including:

- Specific methodology and quality of estimates
- Industry statistics
- The technical situation in the industry
- Emissions and current controls
- Cost and VOC reduction benefit evaluations for the most likely RACT alternatives
- Direct economic impacts.

Each section presents detailed data and findings based on analyses of the RACT guidelines, previous studies of the application of surface coatings on automobiles, interviews, industry public hearing submissions and analysis.

7.1 SPECIFIC METHODOLOGY AND QUALITY OF ESTIMATES

This section describes the methodology for determining estimates of:

- Industry statistics
- VOC emissions
- Processes for controlling VOC emissions
- Cost of controlling VOC emissions
- Economic impact

for the surface coating of automobiles in Georgia.

An overall assessment of the quality of the estimates is detailed in the latter part of this section.

7.1.1 Industry Statistics

The potentially affected facilities were identified from the emission inventory and from Ward's Automotive Yearbook. Because there were only two major companies in the state, these companies were both interviewed.

Detailed industry statistical data for value of shipments, capital expenditures, employment, etc., were not available for the state in secondary sources (only two companies manufacturing). Therefore, these estimates were factored from national data based on the number of units output in the state and study team analysis.

The number of units manufactured in 1976 was obtained from Ward's Automotive Yearbook.

7.1.2 VOC Emissions

Booz, Allen estimated the 1977 VOC emissions based on information provided by the Georgia Department of Natural Resources.

7.1.3 Processes for Controlling VOC Emissions

Processes for controlling VOC emmission for the surface coating of large appliances are described in Control of Volatile Organic Emissions from Existing Stationary Sources--Volume II (EPA-450/2-77-008, May 1977). Both manufacturers were interviewed to ascertain the most feasible types of control for organic emissions in the coating of automobiles.

7.1.4 Cost of Control of VOC Emissions

The costs of control of volatile organic emissions were developed by:

- Determining the alternative types of control systems likely to be used
- Estimating the probable use of each type of control system
- Defining system components
- Developing installed capital costs for modifications of existing systems based on industry estimates, EPA estimates and Booz, Allen study team judgment
- Developing costs of a control system for the likely control alternatives:
  - Installed capital costs
  - Direct operating costs
  - Annual capital charges
  - Energy requirements.
- Aggregating costs to the total industry for the state.

These costs were presented for two scenarios of RACT implementation:

- RACT compliance by 1982
- Modified RACT timing requirements and possibly limitations to meet developing technologies.

Under the first scenario (RACT compliance by 1982), a waterborne system similiar to the systems used in developing RACT guidelines was studied.

Under the second scenario, a high solids enamel topcoat system (or other equivalent technology) that is not fully developed (commercially for automobile coatings) was studied.

7.1.5 Economic Impacts

The economic impacts were determined by analyzing the lead time requirements to implement RACT, assessing the feasibility of instituting RACT controls in terms of capital availability and equipment availability, comparing the direct costs of RACT control to various state economic indicators and assessing the secondary effects on market structure, employment and productivity as a result of implementing RACT controls in Wisconsin.

7.1.6 Quality of Estimates

Several sources of information were utilized in assessing the emissions, cost and economic impact of implementing RACT controls on the surface coating of automobiles in Georgia. A rating scheme is presented in this section to indicate the quality of the data available for use in this study. A rating of "A" indicates hard data, (data that are published for the base year), "B" indicates data that were extrapolated from hard data and "C" indicates data that were not available in secondary literature and were estimated based on interviews, analysis of previous studies and best engineering judgment. Exhibit 7-1, on the following page, rates each study output listed and the overall quality of the data.

EXHIBIT 7-1
U.S. Environmental Protection Agency
SURFACE COATING OF AUTOMOBILES
DATA QUALITY

Study Outputs	Hard Data	B Extrapolated Data	C Estimated Data
Industry statistics		X	
Emissions		X	
Cost of emissions control			X
Economic impact			X
Overall quality of data			X

Source: Booz, Allen & Hamilton Inc.

7.2 INDUSTRY STATISTICS

Industry characteristics, statistics and business trends for automobile assembly plants in Georgia are presented in this section. Data in this section form the basis for assessing the impact of implementing RACT for control of VOC emissions from automobile manufacturing plants in the state.

7.2.1 Size of the Industry

There are three major automobile manufacturing facilities that would be affected by the RACT guidelines in Georgia. General Motors has two assembly plants in Lakewood and Doraville and Ford Motor Company has an assembly plant in Atlanta. Exhibit 7-2, on the following page, presents the potentially affected facilities and the approximate number of automobiles and light duty trucks manufactured in the state.

In 1977, there were approximately 538,000 automobiles manufactured in Georgia, approximately 6.6 percent of the automobiles manufactured in the U.S. There are five states that currently manufacture more automobiles than Georgia but only three (Michigan, Missouri and Ohio) with appreciably more automobile production. The table below presents the percent of U.S. car production by state for the 1976 model year.

State	Percent of U.S. Total Automobile Production
Michigan	33.9
Missouri	9.2
Ohio	8.7
New Jersey	6.8
California	6.7
Georgia	6.6
Wisconsin	6.4
Other states	21.7

Additionally, approximately 95,000 light duty trucks were manufactured at the General Motors plant in Lakewood. The 1977 value of shipments of automobile and light duty trucks in Georgia is estimated to be $3.5 billion. These manufacturing facilities employ approximately 13,500 persons. The capital expenditures for the three plants is not available; however, historically the auto industry nationwide expenditures for new plant and new equipment is 1-2 percent of the value of shipments.

EXHIBIT 7-2
U.S. Environmental Protection Agency
LIST OF POTENTIALLY AFFECTED FACILITIES BY THE RACT GUIDELINE FOR SURFACE COATING OF AUTOMOBILES--GEORGIA

Company or Division	Location	Make and Type of Vehicle Manufactures	Automobile Production for the 1976 Model Year (thousand)	Truck Production for 1976 Model Year (thousand)
General Motors: GM Assembly	Doraville	Chevelle Monte Carlo Cutless	265	
	Lakewood	LeManns Grand Prix	139	95
Ford Motor Company	Atlanta (Hopeville)	Torino	134	—
		Cougar		
Total, Georgia (approximately 6.6 percent of U.S. total automobile production)			538	95

Source: Plants of U.S. Motor Vehicle Manufacturers, 1978, Motor Vehicle Manufacturers Association of the United States, Inc.

7.2.2 Comparison of the Industry to the State Economy

The Georgia automobile and light duty truck assembly industry employs approximately 1 percent of the state labor force, excluding government employees, and approximately 3 percent of the manufacturing labor force. The value of shipments from automobile assembly plants represents approximately 10 percent of the statewide value of products manufactured.

7.2.3 Characterization of the Industry

The RACT guidelines apply only to automobile assembly plants and not to customer shops, body shop or other repainting operations. The automobile assembly industry receives parts from a variety of sources and produces finished vehicles. Various models, usually of the same general body style, may be built on an assembly line. Assembly lines typically operate at 30 to 75 automobiles per hour and produce approximately 4,000 vehicles per year.

The automobile manufacturing industry is unique in that these companies are large and have extensive expertise in the coatings technology developed. The surface coating of the automobile must offer adequate protection against corrosion, as well as provide an attractive appearance and durability for the customer. In developing technologies to meet the market needs, the manufacturers have extensive capital invested in specific technologies. The major difference in current technology within the industry is the raw material and the associated equipment used for top coating applications. General Motors has traditionally utilized lacquer systems, while other manufacturers traditionally utilize enamel coatings. In 1977, only two plants were using waterborne enamels, Van Nuys and South Gate California, both General Motors facilities. For prime coating of automobiles, there has been a recent trend towards cathodic electrodeposition because of the increased coverage uniformity and paint recovery. Some of the anodic electrodeposition facilities installed in the late 1960s and 1970s have converted to cathodic to eliminate odor problems and further improve corrosion protection. However, the majority of the plants in the U.S. utilize spray, dip or flow coating for prime coating operations.

7.3 THE TECHNICAL SITUATION IN THE INDUSTRY

This section presents an overview of the types of coating process alternatives that might be used to reduce emissions from the surface coating of automobiles.

7.3.1 Process Description of Surface Coating of Automobiles

There are two major process areas for the surface coating of automobiles:

- Prime coat
- Topcoat.

This section provides a summary of central technologies that may be used for reducing solvent emissions.

7.3.1.1 Primers

The prime coat serves the dual function of protecting the surface from corrosion and providing for good adhesion of the topcoat. Currently, most primers used are organic solventborne and are applied by a combination of manual and automatic spray, dip or flow coating methods. However, there are a number of new low organic solvent-based primers, now used in limited quantities, that could replace these:

- Electrodeposition primers--These are electrophoretically deposited waterborne primers. The process can be either cathodic or anodic. The cathodic, which was developed more recently, offers an improved corrosion protection but does have slightly more VOC emissions than the anodic process. Many automobile assembly facilities have recently invested substantial capital to convert facilities to the cathodic electrodeposition process.

- Waterborne primers--These are waterborne primers that are applied by spray, dip or flow coating processes. The processes require less capital than an electrodeposition process but do not offer the product quality advantages.

- Powder primers--This technology is still in early development stages but it could offer significant emission reductions. Technical problems to date have been the significant processing changes required and product smoothness.

7 3.1.2 Topcoats

Two types of topcoats are currently used in industry--lacquers and enamels. Most General Motors facilities are based on lacquer technology while the other automobile manufacturers all employ enamel topcoats. There are a number of technology developments which may apply in future periods.

- Waterborne topcoats--Reductions in organic solvent emissions of up to 92 percent from topcoat spray booths and ovens are achievable using waterborne topcoats. The exact reduction depends on both the original coating and the replacement. If, for example the original coating were 12 volume percent solids lacquer (6.5 lbs. of organic solvent per gallon of coating) and the waterborne had 2.8 lbs. of organic solvent per gallon of coating (as do GM coatings in California), reduction would be 92 percent. If the original coating were 33 volume percent solids, reduction would be 70 percent.

  Waterborne topcoats are currently being used at two General Motors automobile assembly plants in California on a full-scale basis. Although there can be no argument as to the technical feasibility of waterborne topcoats, the number of major process modifications necessary to retrofit this technology to an existing plant are significant (often requiring a complete new processing line). Also, the utilization of energy is much greater than for solvent systems.

- Powder coatings--Acrylic powder coatings have been evaluated as topcoats for General Motors and Ford cars on a development basis at Framingham, Massachusetts, and Metuchen, New Jersey. Along with process color change and other difficulties that are potentially correctable, the greatest remaining obstacle to powder utilization as an automotive topcoat is the lack of an acceptable metallic color. This commercial unacceptability of powder metallic colors would be a particular problem since over 50 percent of cars manufactured over the past several years have been metallic.

  Although very low in hydrocarbon emissions, powder coatings do not represent a viable approach for automobile manufacturers in the near-term future.

- High solids (60-80% by volume solids) two-component urethanes--Considerable research effort is being devoted to high solids (60-80% by volume solids) low temperature curing urethane systems. Experience with urethanes in general in the aircraft industry indicates excellent weathering and environmental resistance at the low coating weights required on aircraft, although the urethanes used are not at 60-80 percent solids as applied.

  At this point in time, there does not appear to have been any major evaluation by automotive manufacturers of the higher solids materials.

  High solids urethane systems do offer significant potential in reducing emissions and energy costs, but would not be expected to be available for automotive use in the near future.

  An additional problem with urethanes is the exposure to isocyanates from the coatings. Exposure would have to be minimized to assure worker safety.

- High solids (35-55% by volume solids) dispersion lacquers--Many suppliers have taken an intermediate approach to high solids systems. For example, a 55 percent solids dispersion system is currently in use on trucks in Canada on an advanced development basis. High solids dispersion systems (35 percent) have also recently been evaluated at an Oldsmobile plant.

  None of these, however, have been production proven on automotive lines and additonal development would be required to evaluate their performance.

- High solids (30-62% by volume solids) enamels--All major automobile manufacturers other than General Motors use enamel topcoats. The average solids content of enamels currently being applied is approximately 30 percent; metallic colors usually have a lower solids content. Paint suppliers and the automotive industry are actively attempting to achieve higher solid enamels.

In the short term (1 to 2 years), some higher solids colors may be available for use; however, it is un likely that the full color offering (especially metallics) could be converted to high solids technology.

7.3.2 Emissions and Current Controls

This section presents the estimated VOC emissions from automobile assembly facilities in Georgia and the current level of emission controls in the state. Exhibit 7-3, on the following page, shows the estimated emissions in 1977 from the two major companies.

- The General Motor facility at Lakewood manufactures both automobiles and light duty trucks. The total VOC emissions from this facility are approximately 6,200 tons per year.
  - Prime coat application is by spray and dip methods.
  - Automobile topcoat is a solution acrylic lacquer at approximately 13 percent solids.
  - Light duty topcoat is enamel.
- The General Motors facility at Doraville manufactures only automobiles. The total VOC emissions from this facility are approximately 6,600 tons per year. The coating operations are conventional primer systems and a lacquer topcoat system.
- The Ford Motor facility in Atlanta manufactures only automobiles. The total VOC emissions from this facility were approximately 1,000 tons annually in 1977.
  - Prime coat application is by cathodic electrodeposition.
  - The topcoat is an enamel system at 30 percent solids (75 percent). The light metallic colors have a lower solids content.

EXHIBIT 7-3
U.S. Environmental Protection Agency
GEORGIA VOC EMISSION--SURFACE COATING OF AUTOMOBILES

Facility/Location	Coating Process	Estimated 1977 VOC Emissions (tons per year)
General Motors	Prime spray	1,368
Doraville, GA	Prime dip	266
	Topcoat	4,927
	Repair	40
	Subtotal	6,601
General Motors	Primer	866
Lakewood, GA	Topcoat	5,278
	Repair	23
	Subtotal	6,167
Ford Motor Company	Primer (electrodeposition)	80[a]
Atlanta, GA	Topcoat	860
	Repair	12
	Subtotal	952
TOTAL, Georgia		13,720

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[a] Estimated by Booz, Allen assuming cathodic electrodeposition.

Source Georgia Department of Natural Resources, Booz, Allen & Hamilton Inc.

7.3.3 RACT Guidelines

The RACT guidelines (as recommended in EPA-450/2-77-008) for VOC emission control specify the amount of allowable VOC in pounds per gallon of coating, minus any water in the solvent system. The RACT guidelines have established different limitations for each process operation. These recommended limits are shown in the table below.

Affected Process Operations	Average Lbs. VOC/ Gallons of Coating Minus Water
Prime application, flash-off area and oven	1.9
Topcoat application, flash-off area and oven	2.8
Final repair application, flash-off area and oven	4.8

These limits apply to all objects surface coated in the plant, including the body, fenders, chassis, small parts, wheels and sound deadeners. It does not apply to adhesives.

These guidelines, as stated, are very specific to certain types of control options either in emission limit or timing that may be subject to change by the EPA, in the near future.

- The prime coat application limitations were based on an anodic electrodeposition system followed by a 25 percent solids waterborne surface coat for thickness and improved adhesion of the topcoat. Since the guideline development, it has been recognized that a cathodic electrodeposition system offers additional benefits especially in the areas of increased corrosion protection and odor control. With current coating technology, the 1.9 pounds per gallon limitations of the RACT guidelines cannot be achieved with a cathodic system (emissions would be approximately 2.1 pounds per gallon). In light of continued technology development and potential change in limits, it was assumed for purposes of this anaylsis, that a cathodic electrodeposition process with emissions of approximately 2.1 pounds per gallon would meet the RACT requirements.

- The topcoat limits were based on waterborne systems that were introduced at the General Motors South Gate and Van Nuys, California, facilities to meet Los Angeles emission regulations. For purposes of this analysis, two scenarios were assumed in which RACT topcoat limitations could be met--(1) waterborne coatings and (2) other technology with equivalent emission character. It is anticipated that new technology will be developed which will effect reductions equivalent to waterborne coatings at lower costs and energy use.

7.3.4 Selection of the Most Likely RACT Alternatives

Projecting the most likely industry response for control of VOC emissions in automobile assembly facilities is complicated by the different processing techniques manufacturers have in place and the potential change of recommended RACT limitations. Several general assumptions can be made.

- The RACT limitations as recommended (EPA-450/2-77-008) for prime coat application, flash-off area and oven are specifically based on use of an anodic electrodeposition system followed by a 25 percent solids waterborne coating. Recent technology developments in cathodic electrodeposition provide an improved system (versus anodic electrodeposition) and, therefore, this is likely to be the preferred industry response wherever feasible.

- The RACT limitations, as recommended for topcoat application, flash-off area and oven, are specifically based on use of waterborne coatings at two General Motors facilities. Although this alternative is extremely capital and energy intensive, it is the only currently available proven alternative that would meet the recommended RACT limitations, if compliance is required by the 1982 timeframe.

- Other topcoat coating technologies (such as high solids enamels, urethane enamels or powder coatings) could potentially offer significant emission reduction and be cost effective for manufacturers. However, these technologies are at various stages of development and none have been technically proven for an automotive assembly plant.

- The industry will install incinerators only as a last resort if there is no economically feasible, low solvent coating technology available. Incineration may, however, be used in combination with coatings of reduced solvent content to produce emission levels in accord with the RACT guidelines. For instance, an assembly plant using a topcoat enamel system may use a higher solids enamel and incinerate a portion of the emissions.

- Carbon adsorption systems are not a likely control alternative because of the large air flow rate of the spray system.

Due to the uncertainty of the industry response to the RACT recommended limitations, two scenarios of selection of alternatives were developed for purposes of this study.

- Scenario I (High Side)--the industry response to meet the recommended RACT limitations by 1982 would be:

    - Prime coat--anodic or cathodic electrodeposition

    - Topcoat--waterborne coating

    - Final repair--organicborne enamel with 35 percent solids

- Scenario II (Technology Dependent)--RACT timing requirements and possibly emission limitations are modified to meet developing technologies.

Exhibits 7-4 and 7-5, on the following pages, present the selection of the most likely RACT alternatives under the two scenarios.

EXHIBIT 7-4
U.S. Environmental Protection Agency
SELECTION OF THE MOST LIKELY RACT ALTERNATIVES UNDER SCENARIO I (RACT COMPLIANCE BY 1982)

Processing Area	Control Alternatives	Discussion
Primer	Anodic electrodeposition primer followed by waterborne "surfacer"	Very low VOC emission levels are achievable yet system has some technology disadvantages to other alternatives
	Cathodic electrodeposition primer followed by a waterborne or high solids "surfacer"	Offers improved corrosion protection and eliminates odor problem of anodic "E-coat"
		VOC emission levels are moderately higher than the recommended RACT limitations
	Spray, dip or flow coat primers with incineration	High operating cost for energy demands
Topcoat	Waterborne enamels	Only technologically proven alternative that would meet the RACT requirements
		Extremely high capital cost and energy requirements
Repair	35 percent solids enamel	Technology is not fully developed, i.e., some colors cannot be matched with currently available coatings
	Current or modified coatings with incineration	High operating cost for energy demands

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 7-5(1)
U.S. Environmental Protection Agency
SELECTION OF THE LIKELY RACT ALTERNATIVES UNDER SCENARIO II (MODIFIED RACT TIMING AND POSSIBLY LIMITATIONS)

Processing Area	Control Alternatives	Discussion
Primer	Anodic electrodeposition primer followed by waterborne "surfacer"	Very low VOC emission levels are achievable yet system has some technology disadvantages to other alternatives
	Cathodic electrodeposition primer followed by a waterborne or high solids "surfacer"	Offers improved corrosion protection and eliminates odor problem of anodic "E-coat" VOC emission levels are moderately higher than the recommended RACT limitations
	Other spray, dip or flow coat primers with incineration	High operating cost for energy demands
	Powder coatings	Undeveloped technology however, has potential applications for use on steel or as "surfacer" Low VOC emission levels might be achievable and cost effective
Topcoat	Waterborne enamels	Only technologically proven alternative that would meet the RACT requirements Extremely high capital cost and energy requirements

EXHIBIT 7-5(2)
U.S. Environmental Protection Agency

Processing Area	Control Alternatives	Discussion
	High solids enamels	Technology to achieve the 62 percent solids required by RACT limitations is not developed. However, paint suppliers are optimistic for potential application of up to a 55 percent solids enamel If technology develops only minor modifications would be required at facilities currently using enamels Major modifications would still be required for facilities using lacquer coatings
	Urethane enamels	Technology is not developed Potentially large energy savings and improved properties Toxicity protection is required for workers
	Powder	Technology is not developed Potential energy and recovery savings Color limitations
Repair	35 percent solids enamel	Technology is not fully developed, i.e., some colors cannot be matched with currently available coatings

EXHIBIT 7-5(3)
U.S. Environmental Protection Agency

Processing Area	Control Alternatives	Discussion
	Current or modified coatings with incineration	High operating cost for energy demands

Source: Booz, Allen & Hamilton Inc.

7.4 COST AND VOC BENEFIT EVALUATIONS FOR THE MOST LIKELY RACT ALTERNATIVES

Costs for the two assumed scenarios of alternative VOC emission controls are presented in this section. Under Scenario I, it is assumed that the RACT requirements would be met by a waterborne system. Under Scenario II, it is assumed that the RACT timing requirements (and possibly limitations) are modified to meet developing technologies. The costs presented in this section are based on studies performed by the EPA and automobile manufacturers to determine the estimated costs for actual plants. The study team utilized published data to develop the cost estimate presented in the section. The final section presents an extrapolation of the typical costs for automobiles assembly plants to meet the RACT requirements for the two scenarios.

7.4.1 Costs for Alternative Control Systems under Scenario I

Under Scenario I, it is assumed that the RACT requirements must be met with existing proven technology. Therefore, the following control alternatives are assumed:

- Cathodic or anodic electrodeposition of primers. Although the RACT requirements of 1.9 pounds of VOC emissions per gallon of coating are specific for the anodic process, this analysis assumes that cathodic electrodeposition of waterborne coatings would meet the RACT requirements

- Waterborne topcoat system

- 35 percent volume solids enamel repair system

A electrodeposition waterborne system can be used only directly over metal or other conductive surfaces. Although the system offers an improved product advantage over other types of primer application methods, the conversion represents a significant capital cost. The cost of conversion for a typical electrodeposition system at an automobile assembly plant is presented below. Costs will vary significantly depending on the retrofit situation.

- The installed capital cost would be approximately $10 million to $12 million, not including additional energy requirements (if necessary).

- Direct operating costs (utilities, direct labor and raw materials) would be approximately $20,000 less annually than conventional application techniques.

- Interest, depreciation, taxes and insurance are estimated to be $1.9 million annually (assuming 19 percent of capital investment based on a:
  - 20-year equipment life
  - 10 percent interest rate
  - 4 percent for taxes and insurance.
- Therefore, the total annualized cost of the conversion to an electrodeposition waterborne system would be approximately $1.9 million.
- The additional energy demands are estimated to be approximately 5 million to 6 million kilowatt hours per year.

If the electrodeposition system were anodic, the resulting VOC emissions would be approximately 1.9 pounds of VOC per gallon of coating (including primer surfacer emissions). If the electrodeposition system were cathodic, the resulting VOC emissions would be approximately 2.5 pounds of VOC per gallon of coating. For purpose of analysis of VOC emission reduction, 2.5 pounds per gallon of coating is assumed.

The conversion of the topcoat application to a waterborne system would require extensive modification of the existing facilities, essentially equivalent to the cost of new line. The conversion would require changes such as humidification equipment, a longer spray booth, new ovens, replacement of existing piping with stainless steel piping, sludge handling equipment, floor conveyors (for some facilities) and additional power generating equipment. The conversion cost for a waterborne system has been estimated by the EPA and all the major automobile manufacturers. These estimates may differ by 100 percent depending on the particular facility being studied. After an evaluation of these cost estimates, the study team found that a typical facility is likely to incur the following costs to convert to a waterborne system.

- The installed capital cost would be approximately $40 million to $50 million including additional power requirements.
- Incremental direct operating costs (utilities, direct labor and raw materials) would be approximately $750,000 annually, mostly for energy.
- Interest, depreciation, taxes, and insurance are estimated to be approximately $9 million annually (assuming 19 percent of capital based on a 20-year equipment life, 10 percent interest rate and 4 percent for taxes and insurance).

- The annualized cost of the conversion to a waterborne system would be approximately $10 million.

- The additonal energy demands are estimated to be equivalent to approximately 38,000 equivalent barrels of oil annually.

The resulting VOC emission from a waterborne system would be approximately 2.8 pounds of VOC per gallon of coating.

The cost of conversion to a 35 percent enamel for topcoat repair is assumed to be minimal in relation to the conversion costs for the other coating applications. A 35 percent topcoat repair enamel cannot be obtained today for all types of paints applied. However, this limitation might be met by incinerating a portion of the total emissions to achieve the 4.8 pounds per gallon limitation.

7.4.2 Cost for Alternative Control Systems under Scenario II

Under Scenario II, it is assumed that the RACT timing requirements (and possibly limitations) are modified to reflect developing technologies. Therefore, the following control alternatives are assumed:

- Cathodic or anodic electrodeposition of primers

- High solids enamels, urethane enamels or powder coatings technologies developed for topcoat application

- 35 percent solids enamel used for topcoat repair.

The conversion cost for a electrodeposition waterborne system would be the same as developed for Scenario I.

The conversion of the topcoat application to a high solids enamel, urethane enamel or powder coating would depend on the particular system applied and the current coating technology used by the manufacturer. Therefore, costs were estimated for manufacturers currently using enamels and lacquers.

- For manufacturers who are currently using enamel topcoating, this analysis assumes that they would meet the RACT requirements with high solids enamel technology developments.

  - Under this scenario, minimal capital and operating costs changes would be required as the existing equipment is likely to be adjustable to higher solids coatings.

  - The average VOC emissions per gallon of coating would depend on the high solids enamels that are developed. Depending on the timing constraints, high solid enamels ranging from 40 percent to 63 percent could be achieveable based on projected technology developments that are currently being applied by other industrial sectors.

- For manufacturers that are currently using lacquer topcoat systems, there is likely to be significant capital requirement to meet further technology development:

  - A conversion to high solids enamel is likely to require changes in equipment, such as:

    - Conveyor systems
    - Ovens
    - In-house repair
    - Spray systems
    - Sludge disposal system.

  - The conversion requirements for urethane enamels or powder coatings is at too early a stage to estimate costs.

  - The equipment modifications would depend on the particular technology adapted at these facilities and the available equipment. Based on Booz, Allen study team estimates, the anticipated capital costs are likely to be less than $10 million per facility. Therefore, for purposes of this study, a judgmental analysis leads to the following cost determination to convert current lacquer processing:

    - Capital cost of $10 million

    - Annualized cost of $1.9 million (assuming 19 percent of capital cost for capital related costs).

Exhibit 7-6, on the following page, presents the conversion costs for the two scenarios developed.

7.4.3 Extrapolation to the Statewide Industry

Exhibit 7-7, following Exhibit 7-6, presents the extrapolated costs of meeting the RACT guidelines under two scenarios that were developed. These costs are based upon:

- The estimates of cost of compliance under the two scenarios that were presented in sections 7.4.1 and 7.4.2.
- The three potentially affected facilities in the state:
  - The two General Motors facilities, which would require capital expenditures for primer and topcoat applications
  - The Ford facility, which would require only capital costs for topcoat applications (i.e., a cathodic electrodeposition process has already been installed).

EXHIBIT 7-6
U.S. Environmental Protection Agency
ESTIMATED COST FOR MODEL PLANT TO
MEET AUTOMOBILE RACT REQUIREMENTS

	Capital Cost ($ millions)	Direct Operating Cost ($ millions)	Annualized Capital Cost ($ millions)	Annualized Cost--Rounded ($ millions)	Energy Demand (equivalent barrels of oil)
SCENARIO I					
Primer	10-12	(0.02)	1.5-1.8	1.6	13,000
Topcoat	40-50	0.8	6.0-7.5	8	37,000
Final repair	-	-	-	-	-
Total, Scenario I	50-62	0.78	7.5-9.3	9.6	50,000
SCENARIO II					
Primer	10-12	(0.02)	1.5-1.8	1.6	13,000
Topcoat					
(Enamel facilities/ laquer facilities)	<10/<1	-	<1.5	<1.5	-
Final repair	-	-	-	-	-
Total, Scenario II	10-22	-	1.5-3.3	1.6-3.1	13,000

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 7-7
U.S. Environmental Protection Agency
STATEWIDE COSTS TO MEET THE RACT GUIDELINES FOR AUTOMOBILE ASSEMBLY PLANTS

Characteristic	Scenario I	Scenario II
Number of plants	3	3
1977 VOC emissions (tons per year)	13,700	13,700
Potential emission reduction (tons per year)	11,400	6,900-11,400[a]
VOC emissions after RACT (tons per year)	2,300	2,300-6,800
Capital cost ($ millions, 1977)	160	43
Annualized cost ($ millions, 1977)	27	6
Annualized cost per ton of emission reduction	2,360	525-870

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a. Emission reduction based on average solids concentration of topcoat of 40 percent to 62 percent.

Source: Booz, Allen & Hamilton Inc.

7.5 DIRECT ECONOMIC IMPLICATIONS

This section presents the direct economic implications of implementing RACT controls to the statewide industry, including: availability of equipment and capital; feasibility of the control technology; and impact on economic indicators, such as value of shipments, unit price, state economic variables and capital investment. In this section, both scenarios that were developed for surface coating of automobiles are discussed.

3.5.1 RACT Timing

Under Scenario I, it is assumed that the recommended RACT guidelines must be implemented statewide by 1982. This implies that the automobile manufacturers must have either low solvent coatings or VOC control equipment installed and operating within the next four years. The timing of RACT is discussed for each of the major processes within automobile facilities.

- To meet the RACT requirement for primer coating operations, cathodic or anodic electrodeposition will have to be installed. In general, the industry has been installing the cathodic electrodeposition process over the past few years and many new installations are planned over the next few years.
    - These timing requirements for primers represent a moderate forcing of the current technology trend for most manufacturers.
    - For General Motors, which has two facilities, the conversion to an electrodeposition process represents significant changes in their current process. Construction plans would have to start soon to meet the 1982 timeframe.
- To meet the RACT requirements for topcoating operations, the only proven technology existing today is waterborne coating.
    - Conversion to waterborne coatings represents a complete changeover of existing facilities. Essentially, new production lines would have to be installed at all three affected facilities in Georgia.

    - Construction alone would probably take between three to four years. Although this deadline of construction might be met if Georgia were the only state implementing RACT, it could not be met on a nationwide basis by automobile manufacturers.

- To meet the RACT requirements for final repair, the equivalent of a 35 percent solids enamel must be achieved.

    - At the General Motors facilities, which utilize lacquers, this represents a significant change in technology. Spot repair procedures and possibly conveyor systems would have to be modified for implementation.

    - At General Motors, which utilizes an enamel system, it has not been proven that high solids enamels can be achieved for metallic colors. The timing requirements might have to be met with add-on control equipment in the short run (until technology developments are proven for higher solids enamel repairs).

Under Scenario II, it is assumed that RACT timing requirements are modified, so that implementation would meet developing technologies. The only major processing area where significant timing modifications need to be adapted would be for topcoating (and possibly for the primer surfacer).

- It is likely that higher solids enamels technologies will be developed over the next two or three years, although it is highly unlikely a 62 percent solids enamel could be developed before 1980.

- Topcoat changes at General Motors are likely to be substantial unless an adaptable technology can be developed.

The sections which follow further discuss the feasibility of implementing RACT within the required timeframe and the economic implications.

7.5.2 Feasibility Issues

Technical and economic feasibility issues of implementing RACT controls are discussed in this section.

The automobile manufacturing industry has extensively evaluated most of the approaches to meeting RACT. The feeling in the industry is that RACT cannot be achieved by January 1, 1982, using low solvent coatings--primarily waterborne.

- The capital construction requirements to achieve waterborne topcoat RACT limitations cannot be achieved on a nationwide basis by 1982.
- The RACT controls for primer operations could be achieved by a 1982 timeframe if they are modified to incorporate the cathodic electrodeposition processing technology. However, in some older facilities where changes are extensive, additional time may be required.
- It is probable that the final repair limitations could be achieved (with moderate technology advances) at all automobile facilities currently using enamel systems. The final repair modifications required at General Motors would depend on the future topcoat technology selected to meet RACT requirements.

7.5.3 Comparison of Direct Cost With Selected Direct Economic Indicators

This section presents a comparison of the net increase in the annual operating cost of implementing RACT with automobiles manufactured in the state, the value of wholesale trade in the state and the unit value of automobiles.

Under Scenario I, which assumes that the recommended RACT limitations are met with electrodeposition for primers, waterborne topcoat processes and a 35 percent solids enamel topcoat:

- The capital requirement is estimated to be $160 million, which represents approximately 300 percent of normal capital expenditures (assuming current capital expenditures represent 1.5 percent of value of shipments).
- The net annualized cost increase is estimated to be $27 million, which represents approximately 0.9 percent of the statewide auto industry's value of shipments.

- Assuming a "direct cost pass-through," the net price increase would be approximately $45 per auto or light duty truck manufactured.
- The automobile manufacturing industry is a significant part of the statewide economy, and the direct cost increase of compliance represents approximately 0.1 percent of the value of shipments statewide (all manufacturing industry).

Under Scenario II, which assumes that the RACT timing and possibly limitations are modified to meet technology developments:

- The capital requirement is estimated to be approximately $43 million, which represents approximately 80 percent of normal capital expenditures (assuming capital expenditures represent 1.5 percent of value of shipments).
- The net annualized cost increase is approximately $6 million, which represents approximately 0.2 percent of the value of shipments.
- Assuming a "direct cost pass-through," the price increase would be approximately $10 per car manufactured.
- The direct cost increase of compliance represents approximately 0.02 percent of the value of shipments statewide (all manufacturing industry).

7.5.4 Ancillary Issues Relating to the Impact of RACT

The automobile manufacturers are seeking to have the guidelines altered to encompass a plantwide emissions basis. This would allow a credit from one operation, where emissions were reduced to below the RACT recommended levels, to be applied to another operation that is not in compliance under this proposal. The plant would be in compliance if the total emissions were reduced to the level proposed in RACT. It appears that the impact of this proposed regulation, if accepted, would be a reduction in compliance cost of the RACT requirements. For instance, a manufacturer might lower the emissions from prime coats below the RACT standard to avoid installing emission control equipment for final repair coating operations.

7.5.5 Selected Secondary Economic Impact

This section discusses the secondary impact of implementing RACT in employment, market structure and productivity.

Automobile manufacturing is a significant portion of Georgia's manufacturing industry and Georgia ranks as the sixth largest automobile manufacturing state in the nation.

- If the recommended RACT limitations (Scenario I) require waterborne coating technology, the effect would probably be a total remodeling of existing lines and facilities. These changes could lead to employment and productivity changes if the companies increase line speed during the major modifications required.
- If the RACT limitations are modified to developing technologies, no significant effects on employment and productivity are forecast.

Regardless of the RACT scenario implemented, no significant change in market structure is likely to occur.

- Under Scenario I, all manufacturers would incur cost increases and none of the manufacturers stated that this would result in market structure changes.
- Under Scenario II, General Motors is likely to incur higher costs than other manufacturers but less cost per facility than under Scenario I. General Motors feels that all of the currently proven technology alternatives would result in quality tradeoffs (with the exception of retrofit control equipment).

* * * *

Exhibits 7-8 and 7-9, on the following pages, present a summary of the current economic implications of implementing RACT under the two scenarios studied for automobile assembly plants in the state of Georgia.

EXHIBIT 7-8 (1)
U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS
OF IMPLEMENTING RACT SCENARIO I FOR
AUTOMOBILE ASSEMBLY PLANTS IN THE
STATE OF GEORGIA

SCENARIO I
(RACT Limitations
Implemented By 1982)

. Current Situation	Discussion
Number of potentially affected facilities	Two companies operating three facilities
Indication of relative importance of industrial sector to state economy	1977 value of shipments was approximately $3.5 billion, which represents approximately 10 percent of the state's manufacturing industry. Of all states, Georgia ranks sixth in automobile production
Current industry technology trends	Prime coat--cathodic electrodeposition topcoats--higher solids enamels for manufacturers using enamel systems
1977 VOC emissions (actual)	13,700 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Cathodic electrodeposition for prime coat; manufacturers with enamel topcoat--high solids enamel; manufacturers with lacquer topcoat--unkown
Assumed method of control to meet RACT guidelines	Cathodic electrodeposition for prime coat Waterborne enamels for topcoat High solids enamels for final repair

Affected Areas in Meeting RACT Scenario I	Discussion
Capital investment (statewide)	$160 million (approximately 300 percent of current annual capital expenditures for the industry in the state)
Annualized cost (statewide)	$27 million (approximately 0.9 percent of the industry's 1977 statewide value of shipments)
Price	Assuming a "direct cost pass-through" approximately $45 per automobile manufactured
Energy	Increase of 150,000 equivalent barrels of oil annually primarily for operation of waterborne topcoating systems
Productivity and employment	Conversion to waterborne systems would require total rework of existing processing lines. Major modifications would probably increase efficiency and line speed of older units.
Market structure	Accelerated technology conversion to electrodeposition primer coat.

EXHIBIT 7-8 (2)
U.S. Environmental Protection Agency

SCENARIO I
(RACT Limitations
Implemented By 1982)

Current Situation	Discussion
RACT timing requirements (1982)	Conversion of all automobile assembly plants to topcoating waterborne systems cannot be achieved by 1982 Prime coat RACT limitations are based on anodic electrodeposition systems and need to be modified to reflect cathodic processing. Topcoat RACT limitations are based on waterborne coatings, which is not a cost or energy effective alternative. Final repair RACT limitations areas based on high solids enamel technology which would require major modifications for manufacturers using lacquer systems
VOC emission after RACT control	2,300 tons per year (17 percent of 1977 emission level)
Cost effectiveness of RACT control	$2,360 annualized cost/annual ton of VOC reduction

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 7-9
U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS
OF IMPLEMENTING RACT SCENARIO II FOR
AUTOMOBILE ASSEMBLY PLANTS IN THE
STATE OF GEORGIA

SCENARIO II
(RACT Timing Requirements And
Possible Limitations Are Modified
To Meet Developing Technologies)

Current Situation	Discussion
Number of potentially affected facilities	Two companies operating three facilities
Indication of relative importance of industrial section to state economy	1977 value of shipments was approximately $3.5 billion which represents approximately 10 percent of the state's manufacturing industry. Of all states, Georgia ranks sixth in automobile production
Current industry technology trends	Prime coat--cathodic electrodeposition topcoats--higher solids enamels for manufacturers using enamel systems
1977 VOC emissions (actual)	13,700 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Cathodic electrodeposition for prime coat; manufacturers with enamel topcoat--high sales enamel; manufacturers with lacquer topcoat--unknown
Assumed method of control to meet RACT guidelines	Cathodic electrodeposition for prime coat High solids enamels, urethane enamels or powder coating for topcoat High solids enamel for final repair

Affected Areas in Meeting RACT Scenario II	Discussion
Capital investment (statewide)	$43 million (approximately 80 percent of current annual capital appropriations for the industry in the state)
Annualized cost (statewide)	$6 million (approximately 0.2 percent of the industry's 1977 statewide value of shipments)
Price	Assuming a "direct cost pass-through" approximately $10 per automobile manufactured
Energy	Dependent on technology applied
Productivity and employment	No major effect
Market structure	No major effect--however, General Motors is likely to have higher conversion costs to developing technologies
RACT timing requirements	Primer and final repair limitations could be implemented at most facilities by 1982 Topcoat limitations could be set at a 40 percent to 62 percent solids by 1985 dependent on technology developments
Problem area	Limitations for topcoat are dependent on technology development
VOC emission after RACT control	2,300-6,800 tons per year (17 percent to 50 percent of 1977 emission levels dependent on limitations)
Cost effectiveness for RACT control	$525-$870 annualized cost/annual ton VOC reduction

Source: Booz, Allen & Hamilton Inc.

BIBLIOGRAPHY

"Ford's War On Rust," Industrial Finishing. August 1978.

Carl A. Gottesman, "The Finishing Touch," Coat and Painting. April 28, 1977, pp. 19-24.

"G.M.'s Mel Halstead Looks At...," Industrial Finishing. April 1977, pp. 16-20.

Bruce N. McBane, "Automotive Coatings," Treatise on Coatings, Vol. 4: Formulations, Part I, R.R. Myers and J.S. Long, eds. New York, Marcel Dekker, 1975.

Herbert W. Reiner, "It Pays to Electrocoat," Plating and Surface Finishing. May 1976, pp. 15-20.

R.E. Roberts and J.B. Roberts, "Reducing Solvent Emissions in Automotive Spray Paint," J. Air. Poll. Control Assoc. Vol. 26, No. 4 (April 1976), pp. 353-358.

Joe Schrantz, "The Lincoln Clear Coat Program," Industrial Finishing. July 1978, pp. 20-23.

General Motors Corporation, Recommended VOC Emission Limitations and Technical Support Document for the State of Ohio, July 1978.

Motor Vehicle Manufacturers Association of the U.S., Inc., Plants of U.S. Motor Vehicle Manufacturers. December 1977.

U.S. Environmental Protection Agency, Control of Volatile Organic Emissions from Existing Stationary Sources, Vol. II. EPA-450/2-77-008, May 1977.

Letter to Mr. Ned E. Williams, Director, Ohio Environmental Protection Agency, from Environmental Activities Staff of General Motors Corporation, August 16, 1978.

Private conversations at General Motors, Warren, Michigan.

Private conversations at American Motors, Detroit, Michigan.

Private conversations at Ford Motor Company, Dearborn, Michigan.

8.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT FOR SURFACE COATING OF METAL FURNITURE IN THE STATE OF GEORGIA

This chapter presents a detailed economic analysis of implementing RACT controls for surface coating of metal furniture in the State of Georgia. The chapter is divided into six sections:

- Specific methodology and quality of estimates
- Industry statistics
- The technical situation in the industry
- Cost and VOC reduction benefits for the most likely RACT alternatives
- Direct economic implications
- Selected secondary economic impacts.

Each section presents detailed data and findings based on analyses of the RACT guidelines, previous studies of metal furniture plants, interviews with industry representatives and analysis of findings.

8.1 SPECIFIC METHODOLOGY AND QUALITY OF ESTIMATES

This section describes the methodology for estimating:

- Industry statistics
- VOC emissions
- Processes for controlling VOC emissions
- Cost of controlling VOC emissions
- Economic impact of emission control

for surface coating of metal furniture in Georgia.

The quality of the estimates is described in detail in the last part of this section.

8.1.1 Industry Statistics

Industry statistics on metal furniture manufacturing plants were obtained from several sources. All data were converted to a base year 1977, based on specific scaling factors. The number of establishments for 1977 was based on the Georgia Directory of Manufacturers supplemented by a review of the 1976 County Business Patterns, and verified and refined by interviews with potentially affected metal furniture manufacturing corporations. The number of employees was obtained during interviews with potentially affected metal furniture manufacturers.

The industry value of shipments was estimated by using the national ratio of value of shipments to number of employees for business and institutional furniture, SIC Codes 2522, 2531 and 2542 from the 1976 Annual Survey of Manufactures. This ratio of approximately $40,000 per employee is in agreement with the actual value of shipments to employees ratio for one metal furniture firm in Georgia, based on information supplied by the firm.

8.1.2 VOC Emissions

The VOC emmissions were estimated based on information obtained from the affected facilities with regard to throughput of coating materials, number of coating lines, and coating processes used.

8.1.3 Processes for Controlling VOC Emissions

Processes for controlling VOC emissions for metal furniture plants are described in Control of Volatile Organic Emissions from Stationary Sources, EPA-450/2-77-032. The data provide the alternatives available for controlling VOC emissions from metal furniture manufacturing plants. Several studies of VOC emission control were also analyzed in detail, and metal furniture manufacturers were interviewed to ascertain the most likely types of control techniques to be used in metal furniture manufacturing plants in Georgia. The specific studies analyzed were Air Pollution Control Engineering and Cost Study of General Surface Coating Industry, Second Interim Report, Springborn Laboratories, and informational literature supplied by the metal furniture manufacturers.

8.1.4 Cost of Controlling VOC Emissions for Surface Coating of Metal Furniture

The costs of control of volatile organic emissions for surface coating of metal furniture were developed by:

- Determining the alternative types of control systems likely to be used
- Estimating the probable use of each type of control system
- Defining equipment components
- Developing installed capital costs for modifications of existing systems
- Aggregating installed capital costs for each alternative control system
- Defining a model plant
- Developing costs of a control system for the model plant:
    - Installed capital cost
    - Direct operating cost
    - Annual capital charges
    - Energy requirements

- Extrapolating model costs to individual industry sectors
- Aggregating costs to the total industry for the state.

The model plant used as the basis for estimating the costs of meeting RACT was a solvent based electrostatic spraying operation. The cost of modifications to handle high solids coatings was not considered to be a function of the type of metal furniture to be coated, since no modifications to the production lines are necessary. Modifications are required only to the coatings handling and pumping and spraying equipment, and these would not differ for different types of furniture pieces.

8.1.5 Economic Impacts

The economic impacts were determined by analyzing the lead time requirements to implement RACT, assessing the feasibility of instituting RACT controls in terms of capital availability and equipment availability, comparing the direct costs of RACT control to various state economic indicators and assessing the secondary effects on market structure, employment and productivity as a result of implementing RACT controls in Georgia.

8.1.6 Quality of Estimates

Several sources of information were utilized in assessing the emissions, cost and economic impact of implementing RACT controls on the surface coating of metal furniture in Georgia. A rating scheme is presented in this section to indicate the quality of the data available for use in this study. A rating of "A" indicates hard data (data that is published for the base year), "B" indicates data that was extrapolated from hard data and "C" indicates data that was not available in secondary literature and was estimated based on interviews, analysis or previous studies and best engineering judgment. Exhibit 8-1, on the following page, rates each study output listed and the overall quality of the data.

EXHIBIT 8-1
U.S. Environmental Protection Agency
SURFACE COATING OF METAL FURNITURE DATA QUALITY

Study Outputs	A Hard Data	B Extrapolated Data	C Estimated Data
Industry statistics		X	
Emissions		X	
Cost of emissions control			X
Economic impact			X
Overall quality of data			X

Source: Booz, Allen & Hamilton Inc.

8.2 INDUSTRY STATISTICS

Industry characteristics, statistics and business trends for metal furniture manufacturing plants in Georgia are presented in this section. Data in this section form the basis for assessing the economic impact of implementing RACT for control of VOC emissions from metal furniture manufacturing plants in the state.

8.2.1 Industry Characteristics

Metal furniture is manufactured for both indoor and outdoor use and may be divided into two general categories: office or business and institutional, and household. Business and institutional furniture is manufactured for use in hospitals, schools, athletic stadiums, restaurants, laboratories and other types of institutions, and government and private offices. Household metal furniture is manufactured mostly for home and general office use. No manufacturers of metal household furniture potentially affected by RACT guidelines were identified in the state.

8.2.2 Size of the Industry

Booz, Allen, through interviews, has identified 3 companies participating in the manufacture and coating of metal business and institutional furniture that are potentially affected by RACT guidelines, as shown in Exhibit 8-2, on the following page. These companies accounted for an estimated $18.5 million in business/institutional metal furniture shipments in 1977. This is equivalent to about 0.6 percent of the U.S. value of shipments of business/institutional metal furniture. The number of employees in the three metal furniture manufacturing firms in Georgia is approximately 460.

8.2.3 Comparison of the Industry to the State Economy

A comparison of the value of shipments of metal furniture with the state economy indicates that the metal furniture industry represents about 0.16 percent of the total Georgia value of shipments of all manufactured goods and the three affected facilities represent approximately 0.07 percent. The industry employs approximately 0.3 percent of all people employed in manufacturing in Georgia, and the three affected facilities employ approximately 0.13 percent.

EXHIBIT 8-2
U.S. Environmental Protection Agency
LIST OF MANUFACTURERS POTENTIALLY AFFECTED BY RACT GUIDELINES FOR SURFACE COATING OF METAL FURNITURE IN GEORGIA

Facility Name	Location
HON Company	Cedartown
JEBCO, Inc.	Warrenton
Leggett & Platt, Inc. Masterack Div.	Atlanta

Source: *Georgia Directory of Manufacturers* and Booz, Allen and Hamilton Inc. interviews

8.3 THE TECHNICAL SITUATION IN THE INDUSTRY

This section presents information on metal furniture manufacturing operations, estimated VOC emissions, the extent of current control and the likely alternatives which may be used for controlling VOC emissions in Georgia.

8.3.1 Metal Furniture Manufacturing and Coating Operation

Manufacturing of metal furniture consists of the following steps: fabrication of furniture parts, coating and final assembly. Coating operations usually include surface preparation, coating and curing. These operations are discussed in detail in the EPA guideline series Control of Volatile Organic Emmissions from Existing Stationary Sources, Volume III: Surface Coating of Metal Furniture, EPA-450/2-77-032, December 1977.

8.3.2 Emissions and Current Controls

This section presents the estimated VOC emissions from metal furniture manufacturing facilities in Georgia in 1977 and the current level of emission controls implemented in the state. Exhibit 8-3, on the following page, shows the total emissions from the 3 metal furniture manufacturing facilities to be about 366 tons per year. These emissions were estimated, based on annual throughput of coating materials and solvents obtained through interviews with the manufacturers. None of these manufacturers has implemented complete hydrocarbon emissions controls systems, although two are currently using medium solids paint (38 percent solids) and could use 60 percent solids with existing equipment. Experiments with water based coatings have not provided the quality of finish or the production line speed desired.

8.3.3 RACT Guidelines and Control Options

The emission limitations that can be achievied through the application of Reasonably Available Control Technology (RACT) for the metal furniture coating industry are presented in Exhibit 8-4, following Exhibit 8-3. This emission limit is based on the use of low organic solvent coatings. It can also be achieved with waterborne coatings, and is approximately equivalent (on the basis of solids applied) to the use of an add-on control device that collects or destroys about 80

EXHIBIT 8-3
U.S. Environmental Protection Agency
SUMMARY OF HYDROCARBON EMISSIONS FROM METAL FURNITURE MANUFACTURING FACILITIES IN GEORGIA

Facility Name	No. of Sources	Current Average Hydrocarbon Emissions (Tons/Year)
HON Company	2	165
JEBCO, Inc.	3	100
Leggett & Platt Masterack Div.	2	101
Total Statewide		366

Source: Booz, Allen and Hamilton Inc. Interviews.

EXHIBIT 8-4
U.S. Environmental Protection Agency
EMISSION LIMITATIONS FOR RACT IN SURFACE COATING OF METAL FURNITURE

Affected Facility	Recommended Limitation	
	kg of organic solvent emitted per liter of coating (minus water)	lbs. of organic solvent emitted per gallon of coating (minus water)
Metal furniture coating line	0.36	3.0

Source: Control of Volatile Organic Emissions from Existing Stationary Sources, Volume III: Surface Coating of Metal Furniture, EPA-450/2-77-032, December 1977.

percent of the solution from a conventional high organic solvent coating. In some cases, greater reductions (up to 90 percent) can be achieved by installing new equipment which uses powder or electrodeposited waterborne coatings. A comparison of the various control options is presented in Exhibit 8-5 on the following pages.

8.3.4 Selection of the Most Likely RACT Alternatives

The choice of application of control alternatives, for the reduction of hydrocarbon emissions in existing facilities for the surface coating of metal furniture, requires a line-by-line evaluation. A number of factors must be considered, based on the individual characteristics of the coating line to be controlled. The degree of economic dislocation is a function of these factors.

The first factor to be considered is whether the existing equipment can be used by the substitution of a coating material which will meet the RACT guideline. This alternative would require the least capital expenditure and may minimize production downtime.

If the existing equipment has to be modified, replaced or expanded, factors to consider are the kind of changes that have to be made, the capital costs, the change in operating costs, the length of time needed to make the changes, the effect on the production rate, the operational problems that will have to be handled and the effect on the quality of the product.

Interviews with industry representatives indicate that the affected manufacturers will use their existing spraying equipment and modify it to handle high solids coatings. The reasons given for this preference are that a high quality finish is required, and that extremely high capital costs are required for conversion to waterborne coatings or electrodeposition in relation to the high solids alternative.

EXHIBIT 8-5(1)
U.S. Environmental Protection Agency
RACT CONTROL OPTIONS FOR THE METAL FURNITURE INDUSTRY

Control Options	Affected Facility and Application	Typical Percent Reduction	Comparison of Control Options
Waterborne (electrodeposition, EDP)	Primecoat or single coat	90-95[a]	Provides excellent coverage, corrosion protection and resistance Fire hazards and potential toxicity are reduced Dry off oven may be omitted after cleansing if an iron-phosphate pretreatment is used Good quality control due to fully automated process may be offset by increased electrical requirements for the coating, refrigeration and circulation systems if EDP replaces waterborne flow or dip coating operations. This would not be true if EDP replaces a spraying operation EDP can be expensive on small-scale production lines

EXHIBIT 8-5(2)
U.S. Environmental Protection Agency

Control Options	Affected Facility and Application	Typical Percent Reduction	Comparison of Control Options
Waterborne (spray dip or flow coat)	All applications	60-90[a]	This will likely be the first option considered because of the possibility that these coatings can be applied essentially with existing equipment
			Requires a longer flash-off area than organic solvent-borne coatings
			Curing waterborne coatings may allow a decrease in oven temperature and some reduction in airflow, but limited reduction if high humidity conditions occur
			Spraying electrostatically requires electrical isolation of the entire system. Large lines may be difficult to convert because coating storage areas may be hundreds or thousands of feet away from the application area

EXHIBIT 8-5(3)
U.S. Environmental Protection Agency

Control Options	Affected Facility and Application	Typical Percent Reduction	Comparison of Control Options
Waterborne (spray dip or flow coat) (continued)			Dip or flow coating application requires closer monitoring due to its sensitive chemistry
			Weather conditions affect the application, so flash-off time, temperature, air circulation and humidity must be frequently monitored
			Changes in the number of nozzles may be required
			Sludge handling may be more difficult
Powder (spray or dip)	Top or single coat	95-99[a]	No solid or liquid wastes to dispose of
			Powder may reduce energy requirements in a spray booth and the ovens because less air is required than for solvent-borne coatings and flash-off tunnel is eliminated

EXHIBIT 8-5(4)
U.S. Environmental Protection Agency

Control Options	Affected Facility and Application	Typical Percent Reduction	Comparison of Control Options
Powder (spray or dip) (continued)			Powder can be reclaimed, resulting in up to 98% coating efficiency All equipment (spray booths, associated equipment and often ovens) used for liquid systems must be replaced Powder films cannot be applied in thicknesses of less than 2 mils and have appearance limitations Powder coatings may be subject to explosions Excessive downtime (half-hour) is required during color changes. If powders are not reclaimed in their respective colors, coating usage efficiency drops to 50% to 60%
High solids (spray)	Top or single coat	50-80a	May be applied with existing equipment

EXHIBIT 8-5(5)
U.S. Environmental Protection Agency

Control Options	Affected Facility and Application	Typical Percent Reduction	Comparison of Control Options
High solids (spray) (continued)			Reduces energy consumption because it requires less airflow in the spray booth, oven and flash-off tunnel Potential health hazard associated with isocyanates used in some high-solid two-component systems
Carbon adsorption	Prime, single or top coat (application and flash-off areas)	90^b	Although it is technically feasible, no metal furniture facilities are known to use carbon adsorption Additional energy requirements is a possible disadvantage Additional filtration and scrubbing of emissions from spray booths may be required There is little possibility of reusing recovered solvents because of the variety of solvent mixtures

EXHIBIT 8-5(6)
U.S. Environmental Protection Agency

Control Options	Affected Facility and Application	Typical Percent Reduction	Comparison of Control Options
Carbon adsorption (continued)			Many facilities may require dual-bed units which require valuable plant space
			Particulate and condensible matter from volatilization and/or degradation of resin, occurring in baking ovens with high temperature, could coat a carbon bed
Incineration	Prime, single or topcoat (ovens)	90[b]	These are less costly and more efficient than carbon adsorbers for the baking ovens because the oven exhaust temperatures are too high for adsorption and the high concentration of organics in the vapor could provide additional fuel for the incinerator

EXHIBIT 8-5(7)
U.S. Environmental Protection Agency

Control Options	Affected Facility and Application	Typical Percent Reduction	Comparison of Control Options
Incinceration (continued)			Heat recovery system to reduce fuel consumption would be desirable and would make application and flash-off area usage a viable option

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a. The base case against which these percent reductions were calculated is a high organic solvent coating which contains 25 volume percent solids and 75 percent organic solvent. The transfer efficiencies for liquid coatings were assumed to be 80 percent for spray, 90 percent for dip or flow coat, 93 percent for powders and 99 percent for electrodeposition.

b. This percent reduction in VOC emissions is only across the control device and does not take into account the capture efficiency.

Source: Control of Volatile Organic Emissions from Existing Stationary Sources--Volume II: Surface Coating of Metal Furniture, EPA-450/2-77-032, December 1977.

8.4 COST AND VOC REDUCTION BENEFIT EVALUATIONS FOR THE MOST LIKELY RACT ALTERNATIVES

This section presents the cost for the most likely control systems and associated VOC reduction benefit. First the costs for the model plant are presented, which are then extrapolated to the statewide industry.

8.4.1 Model Plant Costs and VOC Reduction Benefits

A model plant, with two different sizes, was selected for the surface coating of metal furniture. The model included an electrostatic spraying line with outputs of 3 million square feet and 48 million square feet of surface area coated per year. Assuming a one-color single-coating line, the capital, operation and maintenance costs for the model plant were estimated. The cost of pretreatment facilities, ovens and plant building was excluded from total capital costs. The annualized cost includes coating materials, utilities, operation and labor, maintenance labor and material[1] and capital charges.[2] General plant overhead cost was excluded from the annualized cost. The estimated costs for the model base plant and the incremental costs for the most likely control options are presented in Exhibit 8-6 for the electrostatic spraying lines, on the following page.

The assumptions for the cost estimates are discussed in the RACT guidelines document (EPA-450/2-77-032). It should be noted that the incremental costs or savings can change significantly if the underlying assumptions are changed. For example, for two of the facilities that use 35-40 percent solids coating instead of the model plant assumption of 25 percent less savings for conversion to higher solids (70 percent) would result. The savings of $6,000 in direct operating costs for converting from 25 percent to 70 percent solids for Model Plant A-1 becomes a $2,000 savings when converting from 38 percent to 70 percent solids.

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[1] Maintenance material and labor charges were assumed to be approximately equal to 4 percent of the capital cost.

[2] The capital charges were assumed to be 20.66 percent, which includes 10 percent interest, 4 percent taxes and insurance, and 6.66 percent depreciation based on 15-year life.

EXHIBIT 8-6

U.S. Environmental Protection Agency
ESTIMATED COST OF CONTROL FOR MODEL EXISTING ELECTROSTATIC SPRAY COATING LINES

	Model Plant A-1 (3 Million Square Feet/Yr)				Model Plant A-2 (48 Million Square Feet/Yr)			
	Base Plant Cost 25% Solids	Incremental Costs for Conversion			Base Plant Cost 25% Solids	Incremental Costs for Conversion		
		Higher Solids	Waterborne	Powder		Higher Solids	Waterborne	Powder
Installed capital cost ($000)	255	15	15	60	1,200	62	62	317
Direct operating costs (savings) ($000)	175	(6)	5	17	1,113	(81)	50	343
Capital charges[1] ($000/yr)	53	3	3	12	248	13	13	65
Net annualized cost (credit) ($000/yr)	228	(3)	8	29	1,361	(68)	63	408
Solvent emissions controlled (tons/yr)	N/A	21	20	24	N/A	336	314	380
Percent emissions reduction	N/A	86	80	97	N/A	86	80	97
Annulaized cost (credit) per ton of VOC controlled ($/ton)	N/A	(143)	400	1,208	N/A	(202)	201	1,074

Note: 1977 dollars and short tons

[1] The capital charges were assumed to be 20.66 percent, which includes 10 percent interest, 4 percent taxes and insurance, and 6.66 percent depreciation based on 15-year life. This differs from the RACT guideline assumption of 18.6 percent.

Source: Booz, Allen & Hamilton Inc., based on Control of Volatile Organic Emissions from Existing Stationary Sources, Volume III: Surface Coating of Metal Furniture, EPA-450/2-77-032, December 1977.

8.4.2 Extrapolation of Control Costs to the Statewide Industry

Exhibit 8-7, on the following page, presents the extrapolated costs for meeting RACT guidelines for VOC emission control for surface coating of metal furniture to the statewide industry in Georgia. The estimates are based on the following assumptions and methods:

- The 3 plants listed in Exhibit 8-3 that emit a measurable quantity of hydrocarbons were assumed to require controls to comply with the RACT guidelines.
- Based on industry interviews, as well as Booz, Allen estimates, existing spray coating lines were assumed to convert to high solids coating.
- The capital cost of control for high solids spray coating for two facilities was estimated by scaling up the model plant A-1 costs by a capacity factor per coating line determined to be equal to:

  $(\text{actual emissions/model plant emissions})^{0.6}$

  For the HON Company, the capital cost was obtained from the manufacturer during interviews.
- The incremental annual operating savings for high solids spray coating compared to the base case was assumed to be proportional to the amount of emissions reduction and was scaled up from the model plant costs.

The data in Exhibit 8-7 show that the control of VOC for surface coating of metal furniture to meet the RACT guidelines in Georgia would require a statewide capital investment of about $264,000 and result in a statewide net annualized savings of about $10,000. It should be recognized here that the projected savings in annualized costs may not be realized if the underlying assumptions used in estimating the costs were changed.

The conversion to high solids coatings would result in an energy savings due to reduced drying time. For model plant A-1, converting from 25 percent to 70 percent solids coating, the savings is estimated to be equivalent to 550 barrels of oil annually. For a similar plant converting

EXHIBIT 8-7

U.S. Environmental Protection Agency

STATEWIDE COSTS FOR PROCESS MODIFICATIONS OF EXISTING METAL FURNITURE COATING LINES TO MEET RACT GUIDELINES FOR VOC EMISSION CONTROL

Characteristic	Projected Control Option High Solids Spray
Number of plants	3
Number of process lines	7
Uncontrolled emissions (ton/yr)	365
Potential emission reduction (ton/yr)[a]	286
Installed capital cost ($000)[c]	264
Direct annual operating cost (credit) ($000) (1-3 shifts/day)[b]	(65)
Annual capital charges (credit) ($000)[c]	55
Net annualized cost (credit) ($000)	(10)
Annualized cost (credit) per ton of emission reduced ($)	(35)

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a. Based on control efficiency of 86 percent for plants converting from 25 percent solids to 70 percent solids, and 75 percent for plants converting from 38 percent solids to 70 percent solids.

b. Based on cost for model plant A-1 from Exhibit 8-6 and from data provided by selected manufacturers.

c. 20.66 percent of capital cost.

Source: Booz, Allen & Hamilton Inc.

from 38 percent solids to 70 percent solids, the savings is estimated to be equivalent to 250 barrels of oil annually. Assuming that energy savings is proportional to emissions reduction, the savings for the state would be equivalent to approximately 5,000 barrels of oil annually.

8.5 DIRECT EONOMIC IMPACTS

This section presents the direct economic impacts of implementing the RACT guidelines for surface coating of metal furniture, on a statewide basis. The analysis includes the availability of equipment and capital; feasibility of the control technology; and impact on economic indicators, such as value of shipments, unit price (assuming full cost pass-through), state economic variables and capital investment.

8.5.1 RACT Timing

RACT must be implemented statewide by July 1, 1982. This implies that surface coaters of metal furniture must have made their process modifications and be operating within the next three years. The timing requirements of RACT impose several requirements on metal furniture coaters:

- Determine the appropriate emission control system.
- Raise or allocate capital to purchase new equipment or modify existing facilities.
- Acquire the necessary equipment or coating material for emission control.
- Install new equipment or modify existing facilities and test equipment and/or new materials to ensure that the system complies with RACT and provides acceptable coating quality.

The sections which follow discuss the feasibility and the economic implications of implementing RACT within the requirement timeframe.

8.5.2 Feasibility Issues

Technical and economic feasibility issues of implementing the RACT guidelines are discussed in this section.

None of the metal furniture manufacturers potentially affected by RACT has implemented low solvent coatings to date. However, based on interviews with industry representatives, it is predicted that these manufacturers will convert to low solvent spray coatings in order to comply with RACT guidelines. These coating materials may not be available in the desired quality and the variety of colors required by the manufacturers. The development of suitable coating materials in a variety of colors is the key to successful implementation of RACT in the required time.

Another problem likely to be encountered by the metal furniture manufacturers is that of excessive use of the low solvent coatings. Experiments by one manufacturer indicate that personnel accustomed to high solvent coatings are likely to apply more than the desired thickness of coating, thus using more paint. This problem could be alleviated through training of personnel. It is also possible that the increased demand for high solids coatings may raise the price of these coating materials.

Unless major modifications to equipment are required, for example, automated coating lines, the cost of conversion to high solids coatings is not likely to have a significant effect on the implementation of the RACT guidelines for surface coating of metal furniture.

8.5.3 Comparison of Direct Cost With Selected Direct Economic Indicators

The slight change in the annualized cost to the coaters of metal furniture as a result of implementing RACT guidelines is not expected to have a significant effect on the economic situation in the metal furniture industry in Georgia.

The major economic impact, in terms of cost outlay, will be capital related. For the affected industries the capital investment for RACT implementation may represent as much as 60 percent of the normal annual capital expenditures.[1]

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[1] Based on a ratio of capital expenditures to value of shipments for metal furniture manufacturers in the South Atlantic Division, as stated in the 1972 Census of Manufactures; and using the 1977 value of shipments for the three affected manufacturers in Georgia.

8.6 SELECTED SECONDARY ECONOMIC IMPACTS

This section discusses the secondary impacts of implementing RACT on employment, market structure, productivity, and energy consumption.

Employment is expected to remain unchanged. Employment would be reduced if marginally profitable facilities closed, but the present indication from the industry is that no such closures are anticipated.

By converting to high solids coatings, productivity could be increased because manufacturers will be able to get more paint on per unit volume basis and reduce paint application time. However, the necessity of converting to airless guns, with slower application of coatings, could reduce coating line speed and thereby reduce productivity for one manufacturer.

The use of low [illegible]ent coatings by the affected manufacturers is expecte[illegible] result in a net savings of energy equivalent to approximately 5,000 barrels of oil per year.

* * * * *

Exhibit 8-8, on the following page, presents a summary of the direct economic implications of implementing the RACT guidelines for surface coating of metal furniture in the State of Georgia.

EXHIBIT 8-8

U.S. Environmental Protection Agency

SUMMARY OF DIRECT ECONOMIC INPLICATIONS OF IMPLEMENTING RACT FOR SURFACE COATING OF METAL FURNITURE IN GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	There are 3 metal furniture manufacturing facilities
Indication of relative importance of industrial section to state economy	1977 value of shipments was between $30 million and $60 million industry-wide and approximately $18.5 million for three affected facilities
Current industry technology trends	Trend is towards the use of a variety of colors
1977 VOC emissions (actual)	365 tons per year
Industry preferred method of VOC control	Low solvent coatings
Assumed method of control to meet RACT guidelines	Low solvent coatings

Affected Areas in Meeting RACT	Discussion
Capital investment (statewide)	$264,000
Annualized savings (statewide)	Up to $10,000
Price	No major change
Energy	Savings of 5,000 equivalent barrels of oil per year
Productivity	No major impact
Employment	No major impact
Market structure	No major impact
RACT timing requirements (1982)	Companies using a variety of colors may face a problem finding suitable low solvent coatings
Problem area	Low solvent coating in a variety of colors providing acceptable quality needs to be developed
VOC emissions after RACT	80 tons per year (approximately 22 percent of current emissions level)
Cost effectiveness of RACT	Up to $35 annualized savings/ annual ton of VOC reduction

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Source: Booz, Allen & Hamilton Inc.

DRAFT.

BIBLIOGRAPHY

U.S. Environmental Protection Agency, Control of Volatile Organic Emissions from Existing Stationary Sources, Volume III: Surface Coating of Metal Furniture. EPA-450/2-77-032, December 1977.

U.S. Department of Commerce, County Buiness Patterns, 1976.

U.S. Department of Commerce, Census of Manufactures, 1977.

Springborn Laboratories, Air Pollution Control Engineering and Cost Study of General Surface Coating Industry, Second Interim Report, Enfield, CT, August 23, 1977.

Private conversations with:

Hon Company, Cedartown, Georgia
Jelsco Inc., Warrenton, Georgia
Leggett & Platt Inc., Atlanta, Georgia

10.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT FOR SURFACE COATING OF LARGE APPLIANCES IN THE STATE OF GEORGIA

This chapter presents a detailed analysis of the impact of implementing RACT for surface coating of large appliances in the State of Georgia. The chapter is divided into six sections including:

- Specific methodology and quality of estimates
- Industry statistics
- The technical situation in the industry
- Emissions and current controls
- Cost and VOC reduction benefit evaluations for the most likely RACT alternatives
- Direct economic impacts.

Each section presents detailed data and findings based on analyses of the RACT guidelines, previous studies of the application of surface coatings on large appliances, interviews and analysis.

10.1 SPECIFIC METHODOLOGY AND QUALITY OF ESTIMATES

This section describes the methodology for determining estimates of:

- Industry statistics
- VOC emissions
- Processes for controlling VOC emissions
- Cost of controlling VOC emissions
- Economic impacts

for the surface coating of large appliances in Georgia.

An overall assessment of the quality of the estimates is detailed in the latter part of this section.

10.1.1 Industry Statistics

The major appliance industry contains six major industrial areas as defined by the Standard Industrial Code (SIC).

SIC Code	Description
3582	Commercial laundry
3585	Commercial refrigeration and air conditioning
3589	Commercial cooking and dishwashing
3631	Household cooking
3632	Household refrigerator and freezer
3633	Household laundry
3639	Household appliances, N.E.C. (includes water heaters, dishwashers, trash compactors)

Current Industrial Report provides detailed industry statistical data for the major appliance industry on a national basis. However, because of confidentiality and disclosure problems, there is no individual data source which provides a comprehensive analysis of the statistical data for each individual state. Therefore, our methodology to provide statewide major appliance statistical data was as follows:

- A list of potentially affected facilities was compiled from the state emission inventory, associations and trade journals.

- Interviews were performed with some of the manufacturers to validate the list of potentially affected facilities (this list was not 100 percent validated).
- Secondary source data was collected for each of the industry categories from sources such as:
    - Sales and Marketing Management (April 25, 1978)
    - 1972 Census of Manufactures.
- The Booz, Allen study team, utilizing all available inputs, including interviews with selected manufacturers, determined an estimated percent of the total U.S. value of shipments applicable to the state in each SIC category.

10.1.2 VOC Emissions

The Georgia EPA provided a list of five appliance coaters who might be required to meet the RACT guideline requirements. The Booz, Allen study team interviewed these suspected emitters to verify their inclusion in this RACT category and determined their emission levels. Emissions were determined for one company identified as a major emitter in this category and subject to the RACT guidelines.

10.1.3 Processes for Controlling VOC Emissions

Processes for controlling VOC emission for the surface coating of large appliances are described in Control of Volatile Organic Emissions from Existing Stationary Sources--Volume V: Surface Coating of Large Appliances, (EPA-450/2-77-034, December 1977). Several manufacturers of large appliances and coating application equipment were interviewed to ascertain the most feasible types of control for organic emissions in the coating of large appliances, and the extent of modifications required to meet the RACT guidelines.

All manufacturers interviewed agreed that, currently, consideration was being given to meeting the present RACT deadlines through one modification to the existing topcoating equipment (i.e., high solids) and through two possible alternatives to primecoating operations (i.e., waterborne dip or flow coat or high solids), depending on the type of existing equipment. Therefore, the analysis for this report was based on these alternatives. The methodology for the cost analysis is described in the following paragraphs.

10.1.4 Cost of Control of VOC Emissions for Surface Coating of Large Appliances

The costs of control of volatile organic emissions for surface coating of large appliances were developed by:

- Determining the alternative types of control systems likely to be used
- Estimating the probable use of each type of control system
- Defining system components
- Developing installed capital costs for modifications of existing systems
- Aggregating installed capital costs for each alternative control system
- Defining a model plant
- Developing costs of a control system for the model plant:
    - Installed capital cost
    - Direct operating cost
    - Annual capital charges
    - Energy requirements
- Extrapolating model costs to individual industry sectors
- Aggregating costs to the total industry for the state.

The model plant that was used as a basis for establishing the cost of process modification to meet RACT was a solvent-based dip (or flow coat) primecoat and a solvent-based electrostatic bell or disc topcoat. The cost of modification to waterborne dip or flow coat primecoat and to high solids electrostatic disc or bell topcoat was not considered to be a function of the type of major appliance to be coated, since no modifications to the production lines are necessary. Modifications are required only to the coatings handling and pumping and spraying equipment, and these would be approximately the same whether washers, dryers or refrigerators were being coated.

10.1.5 Economic Impacts

The economic impacts were determined by analyzing the lead time requirements to implement RACT, assessing the feasibility of instituting RACT controls in terms of capital availability and equipment availability, comparing the direct costs of RACT control to various state economic indicators and assessing the secondary effects on market structure, employment and productivity as a result of implementing RACT controls in Georgia.

10.1.6 Quality of Estimates

Several sources of information were utilized in assessing the emissions, cost and economic impact of implementing RACT controls on the surface coating of large appliances in Georgia. A rating scheme is presented in this section to indicate the quality of the data available for use in this study. A rating of "A" indicates hard data, (data that are published for the base year), "B" indicates data that were extrapolated from hard data and "C" indicates data that were not available in secondary literature and were estimated based on interviews, analysis of previous studies and best engineering judgment. Exhibit 10-1, on the following page, rates each study output listed and the overall quality of the data.

EXHIBIT 10-1
U.S. Environmental Protection Agency
SURFACE COATING OF LARGE APPLIANCES
DATA QUALITY

Study Outputs	A Hard Data	B Extrapolated Data	C Estimated Data
Industry statistics		X	
Emissions			X
Cost of emissions control			X
Economic impact			X
Overall quality of data			X

Source: Booz, Allen & Hamilton Inc.

10.2 INDUSTRY STATISTICS

Industry statistics and business trends for the manufacture and surface coating of large appliances in Georgia are presented in this section. The discussion includes a description of the number of facilities, a comparision of the size of the major appliance industry to the state economic indicators, a historical characterization of the industry and an assessment of future industry patterns. Data in this section form the basis for assessing the impact on this industry of implementing RACT to VOC emissions in Georgia.

10.2.1 Size of the Industry

The Georgia EPA reports and Booz, Allen interviews have identified five companies participating in the manufacture and coating of large appliances as shown in Exhibit 10-2, on the following page. These companies accounted for between $50 million and $100 million in shipments. The estimated number of employees in 1977 was between 1,000 and 2,000. The data and the sources of information are summarized in Exhibit 10-3, following Exhibit 10-2, and indicate that Georgia shipped an estimated 0.3 percent to 0.7 percent of the U.S. value of shipments in the large appliance industry.

10.2.2 Comparison of the Industry to the State Economy

A comparison of the value of shipments of large appliances (in the SIC categories stated previously) with the state economy indicates that the large appliance industry represents 0.1 percent to 0.4 percent of the total Georgia value of shipments of all manufactured goods. The industry employs between 0.2 percent and 0.4 percent of all people employed in manufacturing in Georgia. These figures are shown in Exhibit 10-4, following Exhibit 10-3, along with the sources of the data.

10.2.3 Historical and Future Patterns of the Industry

The shipments of major appliances have generally followed the economic condition of the country. In the last ten years, sales have generally increased annually, except during the recession in 1974 and 1975. Shipments peaked in 1973 for all major appliances.

Shipments picked up in 1976 and continued to grow in 1977. The outlook through 1982 is a continued annual growth of about 3 percent to 5 percent.

EXHIBIT 10-2
U.S. Environmental Protection Agency
LIST OF MANUFACTURERS, POTENTIALLY AFFECTED BY RACT GUIDELINES, WHO SURFACE COAT LARGE APPLIANCES IN GEORGIA

Facility Name	Location
Alsco Manufacturing Co.	Atlanta
Crispaire Corp.	Cordele
Roper Corp.	Lafayette
Tappan	Dalton
Warren-Sherrer (Division of Kysor)	Conyers

Source: Georgia EPA List of Appliance Coaters and Booz, Allen and Hamilton Inc. interviews.

EXHIBIT 10-3
U.S. Environmental Protection Agency
INDUSTRY STATISTICS--SURFACE COATING OF LARGE APPLIANCES
GEORGIA

SIC Code	RACT Category	U.S. Totals[a] 1977 Estimated No. of Units Shipped (thousand)	U.S. Totals[a] 1977 Estimated Value of Shipments ($ million)	Georgia Totals[a] Estimated Percent of U.S. Shipments	Georgia Totals[a] Estimated Value of Shipments ($ million)	Georgia Totals[a] Estimated No. of Units Shipped (thousand)
3582	Commercial laundry	b	200	None	None	None
3585	Commercial refrigeration and air conditioning	b	9,500	None	Negligible	Negligible
3589	Commercial cooking and dishwashing	b	150	None	None	None
3631	Household cooking	5,000	1,500	3-6	30-60	100-200
3632	Household refrigerator and freezer	7,300	2,000	None	None	None
3633	Household laundry	8,500	1,500	20-25	None	None
3639	Household appliances: Water heaters Dishwashers Trash compactors	9,300	800	1-3	20-40	115-240
	TOTAL		15,650	0.3-0.7	50-100	215-440

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a. Current Industrial Reports, Major Household Appliances, 1977 (issued June 1978) for categories 3631, 3632, 3633 and 3639. 1972 Census of Manufactures Service Industry Machine Shops (issued March 1975 and updated to 1977) for categories 3582, 3585 and 3589. Sales and Marketing Management (April 24, 1978) for categories 3631, 3632, 3633 and 3585.

b. Not available

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 10-4

U.S. Environmental Protection Agency

COMPARISON OF LARGE APPLIANCE STATISTICS WITH STATE OF GEORGIA ECONOMIC DATA

	Estimated Georgia Economic Indicators	Estimated Percent of Georgia Manufacturing Economy Engaged in Large Appliance Manufacturing
Total 1977 value of shipments of all manufactured goods	$30 billion-$35 billion	0.1 to 0.4
Number of employees in manufacturing	450,000-500,000	0.2 to 0.4

Source: *Current Industrial Reports*, Major Household Appliances, 1977 (issued June 1978) *for categories 3631, 3632,* 3633 and 3639; 1972 *Census of Manufactures* Industry Machines and Machine Shops (issued March 1975 and updated to 1977) for categories 3582, 3585 and 3589; *Sales and Marketing Management* (April 25, 1977) for categories 3631, 3632, 3633 and 3585; *Sales and Marketing Management*, April 24, 1978; *Annual Survey of Manufactures*, Statistics for States, Standard Metropolitan Statistical Areas, Large Industrial Counties and Selected Cities, 1976; Booz, Allen & Hamilton Inc.

The growth of the major appliance market will be reflected in the growth of the housing industry and the socioeconomic effects of the trends toward smaller families, single-person households, higher energy costs and the like.

Historical and future growth patterns are shown in Exhibits 10-5 and 10-6, on the following pages.

EXHIBIT 10-5

U.S. Environmental Protection Agency

HISTORICAL U.S. SALES FIGURES--SELECTED MAJOR HOUSEHOLD APPLIANCES FOR 1968-1977

Appliance	Appliance Sales (Millions of Units)									
	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Washer	2.9	4.4	4.1	4.6	5.1	5.5	4.9	4.2	4.5	4.9
Dryer	2.9	3.0	2.9	3.3	3.9	4.3	3.6	2.9	3.1	3.6
Range	4.4	4.5	4.5	4.3	4.8	5.0	4.1	3.6	4.2	4.7
Dishwasher	1.9	2.1	2.1	2.5	3.2	3.7	3.3	2.7	3.1	3.4
Refrigerator	5.2	5.3	5.3	5.7	6.3	6.8	5.9	4.6	4.8	5.7

Source: *Appliance*, April 1978, pp. 37-40.

EXHIBIT 10-6
U.S. Environmental Protection Agency
FIVE-YEAR U.S. SALES FORECAST FOR SELECTED MAJOR HOUSEHOLD APPLIANCES
(1978-1982)

Appliance	Appliance Estimates (Millions of Units)				
	1978	1979	1980	1981	1982
Washer	5.4	5.6	5.7	5.8	5.8
Dryer	4.0	4.2	4.4	4.5	4.6
Range	5.2	5.4	5.6	5.7	5.8
Dishwasher	3.7	3.9	4.1	4.4	4.6
Refrigerator	6.0	6.2	6.4	6.5	6.6

Source: *Appliance*, January 1978, pp. 54-55.

10.3 THE TECHNICAL SITUATION IN THE INDUSTRY

This section presents the process description for the preparation, application and curing of surface coatings for large appliances, estimated VOC emissions from facilities coating large appliances in Georgia and the extent of current control in use.

10.3.1 Large Appliance Process Description

A large appliance plant typically manufactures one or two types of appliances and contains only one or two lines. The lines may range from 1,200 to 4,000 meters (3/4 mile to 2-1/2 miles) in length and operate at speeds of 3 to 15 meters (10 to 50 feet) per minute.

Cases, doors, lids, panels and interior parts for large appliances are stamped from sheet metal and hung on overhead conveyors. The parts are transported to the cleaning and pretreatment sections, which are typically located on the ground floor of the plant.

Exhibit 10-7 and Exhibit 10-8, on the following pages, describe and illustrate the pretreatment, coating and curing processes for a typical large appliance facility.

EXHIBIT 10-7
U.S. Environmental Protection Agency
PRESENT MANUFACTURING TECHNOLOGY DESCRIPTION

MANUFACTURING AND PRETREATMENT PROCESS DESCRIPTION	COATING PROCESS DESCRIPTION	CURING PROCESS DESCRIPTION	TYPICAL COATINGS AND SOLVENTS
Large appliance plant typically manufactures one or two different types of appliances and contains only one or two lines . Lines may range from 1,200 to 4,000 meters (3/4 to 2-1/2 miles) in length . Lines may operate at speeds of 3 to 15 meters (10 to 50 feet) per minute Parts are transported on overhead conveyors . Cleaned in an alkaline solution . Rinsed . Treated with zinc or iron phosphate . Rinsed again . Treated with chromate (if iron phosphate is used) . Dried at 300°C to 400°C in a gas fired oven and cooled before coating	Primecoat or interior single coat (0.5 to 1.0 mils) is applied . Dip coating occurs in a continuously agitated tank . Flow coating occurs in an enclosed booth as the parts move through on a conveyor and are sprayed by stationary or oscillating nozzles - Parts may enter a flash-off tunnel to allow coating to flow out properly . Spray coating occurs in booths either by automatic electrostatic spraying or manually - Flashoff of 7 minutes to allow solvents to rise slowly in the film to avoid popping in the oven Prior to topcoating, the parts are checked for smoothness and manually sanded, "tack-ragged" or retouched with a spray gun	Coated parts are baked for about 20 minutes at 180°C to 230°C (350°F to 450°F) in a multipass oven	Coatings include: . Epoxy . Epoxy-acrylic . Acrylic or polyester enamels . Alkyd resins Solvents include: . Esters . Ketones . Aliphatics . Alcohols . Aromatics . Ethers . Terpenes
Exterior parts may enter a prime preparation booth to check the pretreatment . Parts can be sanded and tack-ragged (wiped) to provide an even finish	Topcoat or exterior single coat (direct-to-metal topcoat (1.0 to 1.5 mils) is applied . Usually applied by automated electrostatic discs, bell or other type of spray equipment . Usually applied in many colors . Applied in side-draft or down-draft spray booths equipped with water wash and undergoes a 10-minute flashoff period Inside of many exterior large appliance parts are sprayed with gilsonite for additional moisture resistance and for sound deadening	Baked for 20 to 30 minutes at 140°C to 180°C (270°F to 350°F) in a multipass oven	

10-8-a

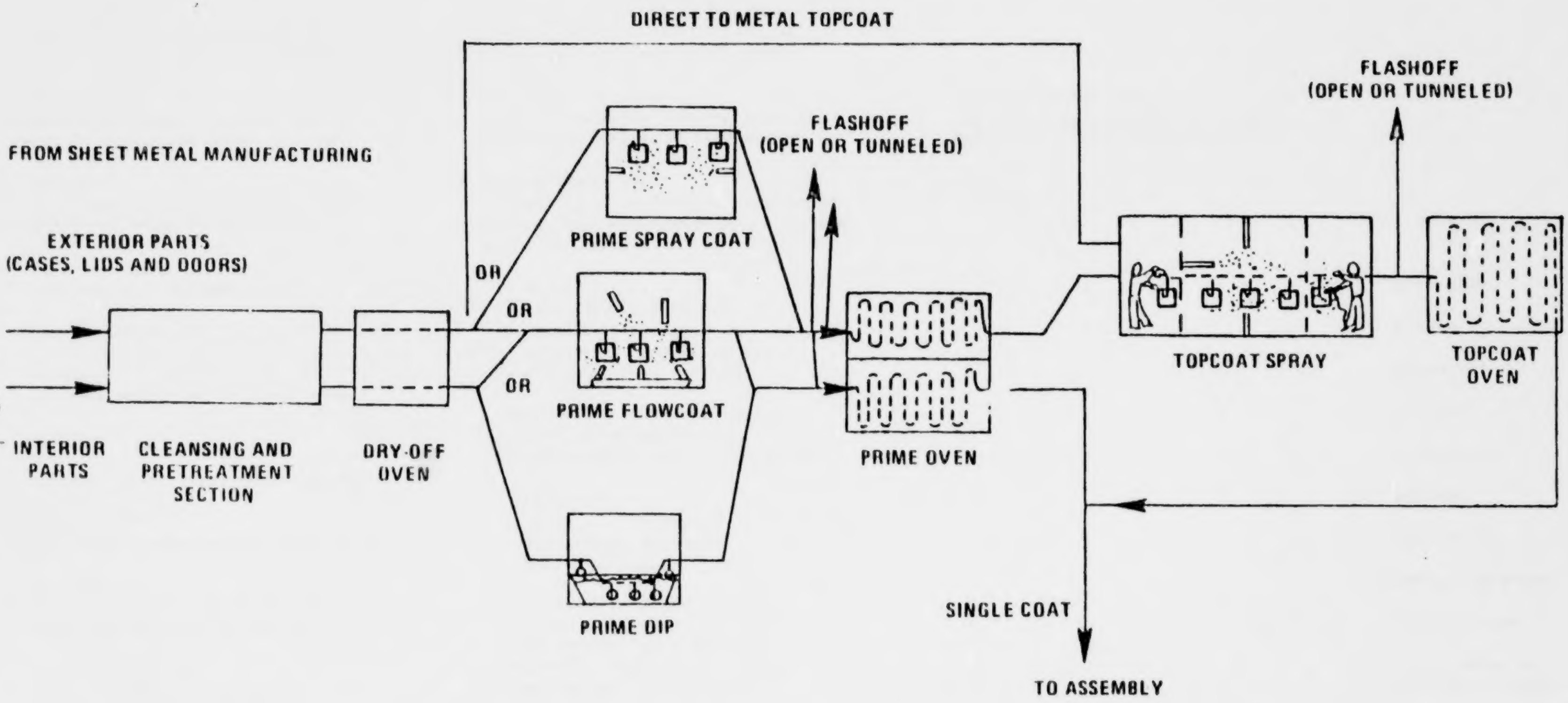
Reproduced from best available copy.

Source: Control Of Volatile Organic Emissions From Existing Stationary Sources--Volume V: Surface Coatings Of Large Appliances, EPA-450/2-77-034, December 1977

EXHIBIT 10-8

U.S. Environmental Protection Agency

DIAGRAM OF A LARGE APPLIANCE COATING LINE


DIRECT TO METAL TOPCOAT
FROM SHEET METAL MANUFACTURING
EXTERIOR PARTS (CASES, LIDS AND DOORS)
INTERIOR PARTS
CLEANSING AND PRETREATMENT SECTION
DRY-OFF OVEN
OR
OR
OR
PRIME SPRAY COAT
PRIME FLOWCOAT
PRIME DIP
FLASHOFF (OPEN OR TUNNELED)
PRIME OVEN
TOPCOAT SPRAY
FLASHOFF (OPEN OR TUNNELED)
TOPCOAT OVEN
SINGLE COAT
TO ASSEMBLY

Source: Control Of Volatile Organic Emissions From Existing Stationary Sources--Volume V: Surface Coating Of Large Appliances, EPA-450/2-77-034, December 1977.

10.4 EMISSIONS AND CURRENT CONTROLS

This section presents information on the distribution of VOC emissions during the coating operation, the estimated VOC emissions in Georgia in 1977 and the current level of emission control implemented in the state.

VOC emissions occur in three areas during the process of coating large appliances. They are the application, flashoff and oven areas. The percent distribution of VOC emissions by area is as follows:

Application Method	Percent of VOC Emission: Application and Flashoff	Percent of VOC Emission: Oven
Dip	50	50
Flow coat	60	40
Spray	80	20

The percent reduction of emissions for prime coating with waterborne dip or flow coat operations was assumed to be 80 percent and for high solids (62 percent volume) topcoat 60 percent. An overall average of 70 percent reduction in VOC emissions is assumed in implementation of RACT guidelines for surface coating of large appliances.

Of the six manufacturers and coaters of large appliances identified by the Georgia EPA and interviewed by the Booz, Allen study team, only one company was verified as being affected by the proposed RACT guidelines. Two companies have emission levels below the RACT and Georgia minimum for control; two are projected to be in compliance; and one is not considered as part of this RACT category.

Exhibit 10-9, on the following page, shows the categorization of five companies studied as stated above. The estimated emissions in Georgia from the one appliance coating facility to be controlled under RACT are 280 tons per year.

10.4.1 RACT Guidelines

The RACT guidelines for control of VOC emissions from the surface coating of major appliances require the following:

- Use of waterborne, high solids (at least 62 percent by volume) or powder coating to reduce VOC emissions
- Use of add-on control devices, such as incinerators or carbon adsorbers.

Exhibits 10-10, 10-11 and 10-12, following Exhibit 10-9, summarize the RACT emission limitations and control options for VOC emissions control for surface coating of large appliances.

EXHIBIT 10-9
U.S. Environmental Protection Agency
RACT DATA SUMMARY FOR ESTIMATED VOC EMISSIONS FOR SURFACE COATING OF LARGE APPLIANCES IN THE STATE OF GEORGIA

Facility Name	Current Average Hydrocarbon Emissions (Ton/Year)	Potential Control Efficiency with RACT (Percent)	Potential Emission Reduction with RACT (Ton/Year)
Alsco Manufacturing Co.	<2[a]	70	<2[a]
Crispaire Corp.	<2[a]	70	<2[a]
Roper Corp.	280	70	196
Tappan[b]	-	-	-
Warren-Sherrer (Division of Kysor)[b]	-	-	-
Total	280		196

10-9-a

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[a] Emission level below EPA & Georgia minimum for RACT implementation

[b] Reported to be in compliance

Source: Georgia EPA list of potential emitters and Booz, Allen interviews

EXHIBIT 10-10

U.S. Environmental Protection Agency EMISSION LIMITATIONS FOR RACT IN THE SURFACE COATING OF LARGE APPLIANCES

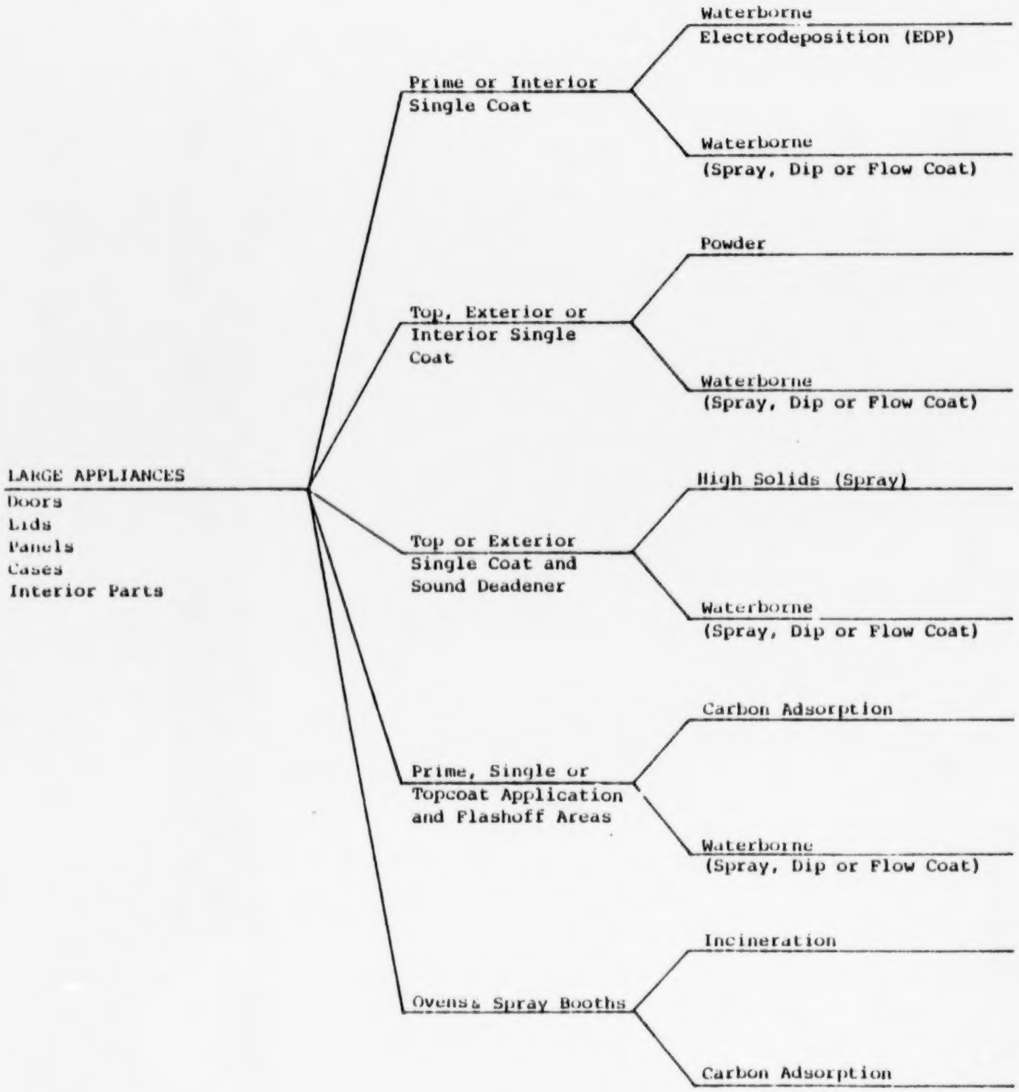
Affected Facility	Recommended Limitations For Low Solvent Coatings kg solvent per liter of coating (minus water)	lbs. solvent per gallon of coating (minus water)
Prime, single or topcoat application area, flash-off area and oven	0.34	2.8

Source: Control of Volatile Organic Emissions from Existing Stationary Sources--Volume V: Surface Coating of Large Appliances, EPA-450/2-77-034, December 1977.

EXHIBIT 10-11

U.S. Environmental Protection Agency

SUMMARY OF APPLICABLE CONTROL TECHNOLOGY FOR COATING OF LARGE APPLIANCE DOORS, LIDS, PANELS, CASES AND INTERIOR PARTS


LARGE APPLIANCES
Doors
Lids
Panels
Cases
Interior Parts
Prime or Interior Single Coat
Waterborne Electrodeposition (EDP)
Waterborne (Spray, Dip or Flow Coat)
Top, Exterior or Interior Single Coat
Powder
Waterborne (Spray, Dip or Flow Coat)
Top or Exterior Single Coat and Sound Deadener
High Solids (Spray)
Waterborne (Spray, Dip or Flow Coat)
Prime, Single or Topcoat Application and Flashoff Areas
Carbon Adsorption
Waterborne (Spray, Dip or Flow Coat)
Ovens & Spray Booths
Incineration
Carbon Adsorption

Reproduced from best available copy.

10-9-C

Source: Control f Volatile Organic Emissions From Existing Stationary Sources--Volume V; Surface Coating of Large Appliances, EPA-450/2-77-034, December 1977.

EXHIBIT 10-12(1)
U.S. Environmental Protection Agency
RACT CONTROL OPTIONS FOR THE LARGE APPLIANCE INDUSTRY

Affected Facility and Application	Control Options	Typical Percent Reduction	Comparison of Control Options
Prime or interior single coat	Waterborne (electrodeposition, EDP)	90-95[a]	Provides excellent coverage corrosion protection and detergent resistance Fire hazards and potential toxicity are reduced Dry off oven may be omitted after cleansing if an iron-phosphate pretreatment is used Lower energy consumption via lower ventilation requirements Good quality control due to fully automated process may be offset by increased electrical requirements for the coating, refrigeration and circulation systems if EDP replaces waterborne flow or dip coating operations This would not be true if EDP replaces a spraying operation EDP can be expensive on small-scale production lines
All applications	Waterborne (spray dip or flow coat)	70-90[a]	This will likely be the first option considered because of the possibility that these coatings can be applied essentially with existing equipment Requires a longer flash-off area than organic solvent-borne coatings Curing waterborne coatings may allow a decrease in oven temperature and some reduction in airflow but limited reduction if high humidity conditions occur

EXHIBIT 10-12(2)
U.S. Environmental Protection Agency

Affected Facility and Application	Control Options	Typical Percent Reduction	Comparison of Control Options
			Spraying electrostatically requires electrical isolation of the entire system. Large lines may be difficult to convert because coating storage areas may be hundreds or thousands of feet away from the application area
			Dip or flow coating application requires closer monitoring due to their sensitive chemistry
			Weather conditions affect the application, so both flash-off time, temperature, air circulation and humidity must be frequently monitored
			Changes in the number of nozzles may be required
			Sludge handling may be more difficult
Top, exterior or interior single coat	Powder	95-99[a]	No solid or liquid wastes to dispose of
			Powder may reduce energy requirements in a spray booth and the ovens because less air is required than for solvent-borne coatings and flash-off tunnel is eliminated
			Powder can be reclaimed resulting in up to 98% coating efficiency
			All equipment (spray booths, associated equipment and often ovens) used for liquid systems must be replaced
			Powder films cannot be applied in thicknesses in less than 2 mils and have appearance limitations
			Powder coatings may be subject to explosions
			Excessive downtime (half-hour) is required during color changes. If powders are not reclaimed in their respective colors, coating usage efficiency drops to 50% to 60%

10-9-e

EXHIBIT 10-12(3)
U.S. Environmental Protection Agency

Affected Facility and Application	Control Options	Typical Percent Reduction	Comparison of Control Options
Top or exterior single coat and sound deadener	High solids (spray)	60-80[a]	May be applied with existing equipment
			Reduces energy consumption because it requires less airflow in the spray booth, oven and flash-off tunnel
			Potential health hazard associated with isocyanates used in some high-solid two-component systems
Prime, single of top coat application and flash-off and spray booths	Carbon adsorption	90[b]	Although it is technically feasible, no larger appliance facilities are known to use carbon adsorption
			Additional energy requirements is a possible disadvantage
			Additional filtration and scrubbing of emissions from spray booths may be required
			There is little possibility of reusing recovered solvents because of the variety of solvent mixtures
			Many facilities may require dual-bed units which will require valuable plant space
			Particulate and condensible matter from volatilization and/or degradation of resin occuring in baking ovens with high temperature could coat a carbon bed
Ovens	Incineration	90[b]	These are less costly and more efficient than carbon adsorbers for the baking ovens because the oven exhaust temperatures are too high for adsorption and the high concentration of organics in the vapor could provide additional fuel for the incinerator
			Heat recovery system to reduce fuel consumption would be desirable and would make application and flash-off area usage a viable option

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a. The base case against which these percent reductions were calculated is a high organic solvent coating which contains 25 volume percent solids and 75 percent organic solvent. The transfer efficiencies for liquid coatings were calculated to be 80 percent, for powders about 93 percent and for electrodeposition about 99 percent.

b. This percent reduction in VOC emissions is only across the control device and does not take into account the capture efficiency.

Source: Control Of Volatile Organic Emissions From Existing Stationary Sources--Volume V: Surface Coatings Of Large Appliances, EPA-450/2-77-034, December 1977

10.4.2 Selection of the Most Likely RACT Alternatives

The choice of application of control alternatives, for the reduction of hydrocarbon emissions in existing facilities for the surface coating of large appliances, requires a line-by-line evaluation. A number of factors must be considered, based on the individual characteristics of the coating line to be controlled. The degree of economic dislocation is a function of these factors.

The first factor to be considered is whether the existing equipment can be used by the substitution of a coating material which will meet the RACT guidelines. This alternative would require the least capital expenditure and minimize production downtime.

If the existing equipment has to be modified, replaced or added to, factors to consider are the kind of changes that have to be made, the capital costs, the change in operating costs, the length of time needed to make the changes, the effect on the production rate, the operational problems that will have to be handled and the effect on the quality of the product.

Interviews with industry representatives indicate a unanimous opinion in the area of choosing the alternative(s) for VOC emission control in coating large appliances. The industry intends to use their existing topcoat application equipment and modify it to handle high solids. Those companies that use a primecoat will convert their conventional solvent systems to either waterborne dip or flow coat or high solids discs or bells. The alternatives are shown in Exhibit 10-13, on the following page.

EXHIBIT 10-13

U.S. Environmental Protection Agency

MOST LIKELY RACT CONTROL ALTERNATIVES FOR SURFACE COATING OF LARGE APPLIANCES IN THE STATE OF GEORGIA

Coat	Existing System	Most Likely Alternative Control Techniques
Prime	Dip or flow coating with conventional solvent	Dip or flow coating with waterborne solvent Electrostatic application with discs or bells of high solids coatings . Preheat paint, or . Use high speed discs or bells
Top	Electrostatic application with discs or bells of conventional solvents	Electrostatic application with discs or bells of high solids coating . Preheat paint, or . Use high speed discs or bells

Source: Booz, Allen & Hamilton Inc.

10.5 COST AND VOC REDUCTION BENEFIT EVALUATIONS FOR THE MOST LIKELY RACT ALTERNATIVES

Cost for the VOC emission control systems are presented in this section. The costs for the alternative primecoat and topcoat applications are described individually. The final section presents an extrapolation of typical costs for surface coating of large appliances to the statewide industry.

10.5.1 Costs for Alternative Control Systems

Estimates of capital and annualized costs are presented for controlling solvent emissions from application areas and curing ovens in primecoats and topcoats of large appliances.

The process modifications involve the converting of a solventborne primecoat or topcoat line to a coating system which emits lesser amounts of VOC. The coating lines and the costs for their modification are shown in Exhibit 10-14, on the following page.

If an existing primecoat conventional-solvent-based dip operation is converted to waterborne dip, the capital costs cover the requirements for additional equipment for close humidity and temperature control during flashoffs and for changeover to materials handling system (pumps and piping) that can handle waterborne coatings without corrosion related problems. Based on these assumptions, the capital installed cost of these modifications is estimated at between $50,000 and $75,000. No additional floor space is required, so the capital allocated building costs remain unchanged. The fixed costs associated with the increased capital requirements are estimated at between $15,000 and $20,000. This includes depreciation, interest, taxes, insurance, administration expenses and maintenance materials.

For the conversion of primecoat or topcoat solvent-based electrostatic disc or bell spray to high solids, the cost of such conversion is based on a number of assumptions: that the paint will have to be preheated to reduce the viscosity prior to application, that the existing pumping system will have to be replaced (including the installation of larger capacity/head pumps and large diameter piping) and that high speed (25,000 to 50,000 RPM) turbine or air drive discs or bells will be required. Also, it is assumed that the type of booth remains unchanged and that the existing painting configuration (including the proper indexing layout) requires no change.

EXHIBIT 10-14
U.S. Environmental Protection Agency
ESTIMATED COST FOR PROCESS MODIFICATION OF EXISTING LARGE APPLIANCE COATING LINES TO MEET RACT GUIDELINES FOR VOC EMISSION CONTROL

Existing System	Most Likely Control Alternative	Major Process Modification	Capital Cost
Primecoat			
Conventional solvent-based dip or flow coat	Waterborne dip of flow coat	Instrumentation for close control of temp-ature and humidity Total repiping and replacement of pumps	Installed capital $50,000 - $75,000 Annualized capital $15,000 - $20,000
Conventional solvent-based electrostatic spray, disc or bell	High solids electrostatic	Pre-heating system Installation of high disc or bells Repiping for larger line sizes and possible coatings pump replacements	Installed capital $50,000 - $75,000 Annualized capital $15,000 - $20,000
		Major revamp of booth, line configuration and air handling system in addition to changes stated above	Installed capital $150,000 - $250,000 Annualized capital $37,000 - $63,000
Topcoat			
Conventional solvent-based electrostatic spray, disc or bell	High solids electrostatic	Pre-heating system Installation of high speed disc or bells Repiping for larger line sizes and possible coatings pump replacement	Installed capital $50,000 - $75,000 Annualized capital $15,000 - $20,000
		Major revamp of booth, line configuration and air handling system in addition to changes stated above	Installed capital $150,000 - $250,000 Annualized capital $37,000 - $63,000

Source: Booz, Allen & Hamilton, Inc.

Based on these assumptions, the capital installed cost of these modifications is estimated at between $50,000 and $75,000. No additional floor space is required so the capital allocated building costs remain unchanged. The fixed costs associated with the increased capital requirements are estimated at between $15,000 and $20,000. This includes depreciation, interest, taxes, insurance, administration expenses and maintenance materials.

Each paint application conversion to meet RACT has its own unique characteristics. Where such conversions require major changes in booth structure, paint application techniques, and air handling system, the costs will be considerably higher than the figures stated above. A first pass estimate at these major changes indicates a capital requirement of $150,000 to $250,000 per booth.

The annual operating expenses will not change appreciably because the manpower requirements remain the same for the two systems. There will be a minor savings in the utilities, associated with the oven curing of the high solids coating. This could amount to about $1 per hour of operation time ($2,000 to $6,000 per year per line (equivalent to 700 cubic feet of natural gas/hour/line).

The overall cost of coating materials may increase slightly even though conversion to water-based or high solids coatings will eliminate the need for solvent thinning. This overall increase is expected because of the anticipated price increases in the coatings that will be required to meet the RACT guidelines. At this time definitive numbers in change of paint prices cannot be developed but an overall paint cost increase of between 10 percent and 20 percent may be anticipated.

10.5.2 Extrapolation to the Statewide Industry

Exhibit 10-15, on the following page, extrapolates the costs for meeting RACT guidelines for VOC emission control for surface coating of large appliances to the statewide industry in Georgia. The estimates are based on the following assumptions:

- All large appliance coaters will implement the control alternatives stated in this report to comply with RACT.
- The distribution of primecoat and for topcoat applications as per industry interview is 50 percent of the coaters topcoat only; the other half both topcoat and primecoat the appliances unless specific information was available for individual facilities.

EXHIBIT 10-15

U.S. Environmental Protection Agency

STATEWIDE COSTS FOR PROCESS MODIFICATIONS OF EXISTING LARGE APPLIANCE COATING LINES TO MEET RACT GUIDELINES FOR VOC EMISSION CONTROL

GEORGIA

Characteristic	Plants with Topcoat Process Only	Plants with Primecoat and Topcoat Process	Total
Number of plants	-	1	1
Number of process lines	1	1	2
Estimated value of shipments ($ million)	-	40-80[a]	40-80[a]
Uncontrolled emissions (Ton/yr)	-	280	280
Potential emission reduction (Ton/yr)	-	196	196
Installed capital cost[b] ($ Thousand)	-	150	150
Direct annual operating cost (credit) ($ Thousand) (1-3 shifts/day)	-	(2-5)	(2-5)
Annual capital charges[b] ($ Thousand)	-	38	38
Net annualized cost[c] ($ Thousand)	-	33[d]-36[e]	33[d]-36[e]
Annual cost per ton or emission reduced ($)	-	168[d]-185[e]	168[d]-185[e]

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a. Represents estimated value of shipments of affected facility only

b. Figures represent the upper limit of the installed capital cost, i.e., $75,000 per modification and annual capital charge of $20,000 per modification/year.

c. Net annualized cost is the summation of the direct annual operating cost and the annual capital charges

d. Represents a three shift/day operation

e. Represents a one shift/day operation

Source: Booz, Allen & Hamilton Inc.

- The five plants identified by the Georgia EPA and from Booz, Allen interviews represent the majority of all the state industry production of large appliances.

Actual costs to large appliance coaters may vary depending on the type of control alternative, manufacturer's equipment and coating material selected by each manufacturing facility.

Based on the above assumptions, the total capital cost to the industry in Georgia for process modifications to meet RACT guidelines is estimated at approximately $150,000. The annual cost is estimated at $168-$185 per ton of emission controlled for facilities that both prime and topcoat.

10.6 DIRECT ECONOMIC IMPACTS

This section presents the direct economic impacts of implementing the RACT guidelines for surface coating of large appliances on a statewide basis. The analysis includes the availability of equipment and capital; feasibility of the control technology; and impact on economic indicators, such as value of shipments, unit price (assuming full cost pass-through), state economic variables and capital investment.

10.6.1 RACT Timing

RACT must be implemented statewide by January 1, 1982. This implies that surface coaters of large appliances must have made their process modifications and be operating within the next three years. The timing requirements of RACT impose several requirements on major appliance coaters:

- Determine the appropriate emission control system.
- Raise or allocate capital to purchase equipment.
- Acquire the necessary equipment for emission control.
- Install and test the emission control equipment to insure that the system complies with RACT.
- Generate sufficient income from current operations to pay the additional annual operating costs incurred with emission control.

The sections which follow discuss the feasibility and the economic implications of implementing RACT within the required timeframe.

10.6.2 Technical Feasibility Issues

Technical and economic feasibility issues of implementing the RACT guidelines are discussed in this section.

Two of the six major appliance manufacturers interviewed have implemented the control alternatives discussed in this report. One company has converted its conventional solvent coating operation to water reducible coating.

A second operation has converted to powder coating since it is a relatively new facility and could more easily adapt to the requirements of the powder coating option.

The equipment manufacturers interviewed have indicated that present technology is available to handle and apply high solids (greater than 62 volume percent solids) using electrostatic discs or bells.

The facility which will be required to meet the RACT guidelines in Georgia is expected to convert to high solids for its single coat (topcoat) system. The equipment manufacturers interviewed have indicated that present technology is available to handle and apply high solids (greater than 62 volume percent solids) using electrostatic discs or bells but these systems have not been commercially proven. These systems require the use of pre-heaters and high speed application.

In addition, high solids coating material suppliers indicated that sufficient quantities of paint would be available to meet the expected market demand. Application equipment manufacturers have indicated that, even with the projected demand for their equipment, they can maintain a 10-week to 12-week delivery schedule. However, we believe that significant delivery delay may occur if all appliance coaters require delivery of such equipment within the same timeframe.

10.6.3 Comparison of Direct Cost with Selected Direct Economic Indicators

The net increase in the annual operating cost to the coater of large appliances represents approximately 0.05 percent of the industry's 1977 value of shipments manufactured in the state. This increase may translate to an approximate cost increase of $0.25 per unit of household appliance coated; for the one company affected the average estimated cost of a unit is $240.

The major economic impact in terms of cost to individual companies will be capital related rather from increased annual operating costs. The capital required for RACT compliance will represent a significant amount of capital appropriations for the companies affected.

10.6.4 Selected Secondary Economic Impacts

This section discusses the secondary impact of implementing RACT on employment, market structure and productivity.

Employment is expected to remain unchanged. Employment would be reduced if marginally profitable facilities closed, but the present indication from the industry is that no such closures are anticipated.

It appears that implementation of the RACT guidelines will have no significant impact on the present market structure. The major appliance industry can be characterized as being highly competitive and manufacturers interviewed state that the regulation may present some cost inequities to smaller and/or less profitable production lines, i.e., direct cost increases will probably not be passed along in the marketplace in the form of a price increase and will further deteriorate the profit position of marginally profitable operations.

Productivity for those coaters who are topcoating only with high solids could be increased because they will be able to get more paint on per unit volume and reduce paint application time.

* * *

Exhibit 10-16, on the following page, presents a summary of the current economic implications of implementation RACT for surface coating of large appliances in the state of Georgia.

EXHIBIT 10-16

U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR SURFACE COATING OF LARGE APPLIANCES IN THE STATE OF GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	There are five major large appliance manufacturer and coaters, only one of which will be affected by the guidelines
Indication of relative importance of industrial section to state economy	1977 statewide value of shipments was estimated at $75 million and represents 0.5 percent of the estimated $15 billion U.S. value of shipments of the major appliance industry
1977 VOC emissions (actual)	280 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Waterborne primecoat and high solids topcoat
Assumed method of VOC control to meet RACT guidelines	Waterborne primecoat and high solids topcoat

Affected Areas in Meeting RACT	Discussion
Capital investment (statewide)	$150,000
Annualized cost (statewide)	$35,000 which represents 0.05 percent of the industry's 1977 statewide value of shipments.
Price	Assuming a "direct cost pass-through"--increase of $0.25/unit for household appliances (based on an average price of $240 per unit appliance)
Energy	Reduced natural gas requirements in the curing operation (equivalent to 800 barrels of oil per year)
Productivity	No major impact
Employment	No major impact
Market structure	No major impact
RACT timing requirements (1982)	Some problem meeting equipment deliveries and installation are anticipated if equipment vendors are overloaded with orders
Problem area	Commercial application of high solids (greater than 62% by volume) has not been proven
VOC emission after RACT control	84 tons/year (30 percent of 1977 emission level)
Cost effectiveness of RACT control	$175 annualized cost/ton VOC reduction

Source: Booz, Allen & Hamilton, Inc.

BIBLIOGRAPHY

Appliance, April 1978.

Annual Survey of Manufactures, 1976.

Census of Manufactures, Industry Machines and Machine Shops, 1972.

Current Industrial Reports, Major Household Appliances, 1977.

Sales and Marketing Management, April 24, 1978.

U.S. Environmental Protection Agency, Control of Volatile Organic Emissions from Existing Stationary Sources--Volume V: Surface Coating of Large Appliances. EPA-450/2-77-034, December 1977.

Private conversations with:

Alsco Manufacturing Company, Atlanta, Georgia
Crispaire Corporation, Cordele, Georgia
Roper Corporation, Lafayette, Georgia
Tappan, Dalton, Georgia
Warren-Shearer, Conyers, Georgia

11.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT FOR SOLVENT METAL CLEANING (DEGREASING) IN THE STATE OF GEORGIA

This chapter summarizes the estimated economic impact of the implementation of reasonably available control technology for volatile organic compound emissions from solvent metal degreasers in areas that are designated as non-attainment in Georgia. Although there may be some facilities outside the 12 county non-attainment area (facilities with potential VOC emissions over 100 tons) requiring control of solvent metal degreasing, for purposes of this analysis, they are not included. Solvent metal degreasing is the process of cleaning the surfaces of articles to remove oil, dirt, grease and other foreign material by immersing the article in a vaporized or liquid organic solvent. The chapter is divided into five sections:

- Specific methodology
- Industry statistics
- Estimated costs of RACT implementation
- Direct economic impacts
- Selected secondary economic impacts.

Each section presents detailed data and findings based on analysis of the RACT guidelines; previous studies of metal degreasing; interviews with degreaser users and with equipment and material suppliers; and a review of pertinent published literature.

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[1] The economic impact of RACT guidelines in the state of Georgia is examined for non-attainment counties only. All estimates which follow in this chapter for the state of Georgia are for the following counties only: Clayton, Columbus, Cobb, Coweta, Dekalb, Douglas, Fayette, Fulton, Gwinett, Henry, Paulding and Rockdale.

11.1 SPECIFIC METHODOLOGY

11.1.1 Background

Solvent metal cleaning describes those processes using nonaqueous solvents to clean and remove soils from metal surfaces. These solvents, which are principally derived from petroleum, include petroleum distillates, chlorinated hydrocarbons, ketones and alcohols. Organic solvents, such as these, can be used alone or in blends to remove water-insoluble soils for cleaning purposes and to prepare parts for painting, plating, repair, inspection, assembly, heat treatment or machining.

Solvent metal cleaning can be divided into three categories, cold cleaning, open top vapor degreasing and conveyorized degreasing.

Cold cleaner operations include spraying, brushing, flushing and immersion of articles in a solvent. The solvent is occasionally heated but always remains well below its boiling point.

The two basic types of cold cleaners are maintenance cleaners and manufacturing cleaners. The maintenance cold cleaners are usually simpler, less expensive and smaller. They are designed principally for automative and general plant maintenance cleaning. Manufacturing cold cleaners usually give a higher quality of cleaning than maintenance cleaners do, and are thus more specialized. Manufacturing cold cleaning is generally an integral stage in metal working production. There are fewer manufacturing cold cleaners than maintenance cleaners, but the former tend to emit more solvent per unit because of the larger size and workload. Manufacturing cleaners use a wide variety of solvents, whereas maintenance cleaners use mainly petroleum solvents such as mineral spirits (petroleum distillates and Stoddard solvents). Some cold cleaners can serve both maintenance and manufacturing purposes and are thus difficult to classify.

Cold cleaners are estimated to result in the largest total emission of the three categories of degreasers because there are so many of these units (more than 1 million nationally) and because much of the waste solvent that is disposed of is allowed to evaporate.

Open top vapor degreasers clean only one workload at a time. They clean through the condensation of hot solvent vapor on colder metal parts. The condensing solvent both dissolves oils and provides a washing action to clean the parts. The selected solvents boil at much lower temperatures than do the contaminants; thus, the solvent/soil mixture in the degreaser boils to produce an essentially pure solvent vapor. One section of the degreaser is equipped with a heating system that uses steam, electricity or fuel combustion to boil the solvent. As the solvent boils, the dense solvent vapors displace the air within the equipment. The upper level of these pure vapors is controlled by condenser coils which are supplied with a coolant such as water. Nearly all vapor degreasers are equipped with a water separator which allows the water (being immiscible and less dense than solvents) to separate from the solvent and decant from the system while the solvent flows from the bottom of the chamber back into the vapor degreaser.

The third category of degreasers is conveyorized degreasers. There are several types operating both with cold and vaporized solvents. The types of conveyorized degreasers include crossrod, rotating wheels, conveyor belts, and monorails as well as other systems which convey the parts through the degreasing medium.

In conveyorized equipment, most, and sometimes all, of the manual parts handling associated with open top vapor degreasing has been eliminated. Conveyorized degreasers are nearly always hooded or covered. The enclosure of a degreaser diminishes solvent losses from the system as the result of air movement within the plant. Conveyorized degreasers are used by a broad spectrum of metal working industries but are most often found in plants where there is enough production to provide a constant stream of products to be degreased.

The EPA has estimated[1] that about 1.3 million cold cleaners operate in the U.S.; about 70 percent are used in maintenance or service cleaning and 30 percent in manufacturing. There are also an estimated 22,200 open top vapor degreasers and 4,000 vapor conveyorized degreasers. In 1975, estimated emissions in the United States from these cleaners exceeded 700,000 metric tons, making solvent cleaning the fifth largest stationary source of organic emissions.

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[1] Control of Volatile Organic Emissions from Solvent Metal Cleaning, EPA-450/2-77-022, November 1977.

As recently as 1974, degreasing operations were exempt from regulation in 16 states, since they rarely emitted more than the 3,000 pounds per day of volatile organic compounds (VOC) which was the regulatory level then in effect in these states. They could also qualify for exemption by the substitution of a solvent not considered to be photochemically active. However, the EPA's current direction is toward positive reduction of all VOC emissions, and the EPA has proposed control technology for solvent metal cleaning operations which can achieve sizeable total VOC emission reduction. This technology involves the use of proper operating practices and the use of retrofit control equipment.

Proper operating practices are those which minimize solvent loss to the atmosphere. These include covering degreasing equipment whenever possible, properly using solvent sprays, employing various means to reduce the amount of solvent carried out of the degreaser on cleaned work, promptly repairing leaking equipment and most important, properly disposing of wastes containing volatile organic solvents.

In addition to proper operating practices, many control devices can be retrofitted to existing degreasers; however, because of the diversity in their designs, not all degreasers require the same type of control devices. Small degreasers using a room temperature solvent may require only a cover, whereas large degreasers using boiling solvent may require a refrigerated freeboard chiller or a carbon adsorption system. Two types of control equipment which will be applicable to many degreaser designs are drainage facilities for cleaned parts and safety switches and thermostats, which prevent large emissions from equipment malfunction. These controls, the types of degreasers to which they can be applied and the expected emission reductions are described later in this chapter.

11.1.2 Method of Estimation of the Number of Degreasers

Subsequent estimation of the economic impact of implementing the proposed RACT for solvent metal cleaning is based upon a determination of the number of solvent metal cleaners in the state. This determination was made on the basis of a detailed industrywide study of metal degreasing in the U.S., conducted by the Dow Chemical Company under contract to the EPA. The results of the study are reported in: Study to Support New Source Performance Standards for Solvent Metal Cleaning Operations, Contract No. 68-02-1329, June 30, 1976.

The report was based on a telephone survey of more than 2,500 plants in the metal working industry (SIC groups 25, 33, 34, 35, 36, 37, 38 and 39) with more than 19 employees. The report presents estimates of the:

- Percentage of U.S. plants using solvent degreasing
- Percentage of plants using cold cleaners, open top vapor degreasers or conveyorized cleaners
- Average number and type of vapor degreasers used in these plants
- Distribution of these quantities by region.

All of these quantities are further identified by the eight metal working industries. In the report (based on the 1972 Census of Manufactures) 15,294 open top and 2,796 conveyorized vapor degreasers were estimated to be in use in the eight SIC groups; an additional 5,000 to 7,000 open top degreasers were estimated[1] to be in use in 1972 in manufacturing or service firms not included in one of the eight SIC groups or in firms with less than 20 employees.

To determine the number of open top and conveyorized vapor metal degreasers in the 12 non-attainment areas, first the number of plants with more than 19 employees in each of the eight SIC groups was determined. The average number of plants using solvent metal degreasing and the average number and type of cleaners used per plant were then obtained by using the factors presented in the Dow report. The results of these calculations and the factors used are tabulated in Exhibit 11-1, in section 11.2. The total number of open top degreasers was then estimated by multiplying the number expected to be used in the eight metal working SIC groups by the ratio of 22,200/15,200 (the ratio of total open top units in the U.S. to those used in the eight SIC groups in the U.S.).

Because of their expense and function, conveyorized vapor degreasing units are most likely to be used in manufacturing only. Therefore, the total number of these units in the 12 county non-attainment area was assumed to be the same as that calculated for the eight SIC metal working industries. The total number of conveyorized cleaners, vapor and cold, was then determined by multiplying the number of vapor conveyorized cleaners by 100/85, the EPA[1] estimated ratio of total conveyorized cleaners to vapor conveyorized cleaners in the U.S.

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[1] Interviews with Parker Johnson, Vice President, Sales, Baron-Blakeslee Corp., Cicero, Illinois and with Richard Clement, Sales Manager, Detrex Chemical, Detroit, Michigan, July 1978.

The number of cold cleaners in the 12 county non-attainment area was based on the Dow estimates of cold cleaning done in plants in the eight SIC metal working industries and the EPA estimate of 1,300,000 cold metal cleaners in the U.S., which include 390,000 in manufacturing use and 910,000 in maintenance or service use.[2] Then:

- The EPA estimates of all cold cleaners in manufacturing use in the U.S. were multiplied by the ratio of the number of plants in the metal working industries (SICs 25 and 33-39) in the non-attainment counties to the number in the U.S.

- The EPA estimates of all cold cleaners in maintenance and service use in the U S. were multiplied by the ratio of the number of plants in the metal working industries plus selected service industries (SIC codes 551, 554, 557, 7538, 7539, 7964) for the affected areas to the number in the U.S. These service industries are expected to have at least one or more cold cleaners.

  - SIC 551 applies to industries categorized as new or used car dealers.

  - SIC 554 applies to industries categorized as gasoline service stations.

  - SIC 557 applies to industries categorized as motorcycle dealers.

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[1] Control of Volatile Organic Emissions from Solvent Metal Cleaning, EPA-450/2-77-022, November 1977.

[2] Cold cleaners in manufacturing use are meant to include only those cleaners employed in the manufacturing process; cold cleaners in maintenance and service use are those employed for this purpose by either manufacturing or service establishments.

- SIC 7538 applies to industries categorized as general automotive repair shops.
- SIC 7539 applies to industries categorized as automotive repair shops, n.e.c.
- SIC 7964 applies to industries categorized as armature rewinding shops.

The estimates of the total number of cold cleaners in the affected state obtained by these calculations are tabulated in Exhibit 11-2.

11.1.3 Method of Estimation of Affected Degreasers

The RACT guidelines propose several exemptions for degreasers based on size, type of solvent used or emission rate.

- The RACT guidelines apply to cleaners with emissions over 15 pounds in any one day or 3 pounds in any one hour whichever is greater. It has been estimated[1] that about 70 percent of cold cleaners would have VOC emissions less than this and would not be affected.
- Cleaners used exclusively for chemical or physical analysis or determination of product quality and acceptance are to be exempt. Since few such cleaners exist, no correction was made to the estimated number of cleaners used in determining the estimated compliance costs.
- Those cleaners using 1,1,1-trichloroethane and trichlorotrifluoroethane are to be exempt. Estimates of the number of open top degreasers which use either of these solvents range from 35 percent to 60 percent.[2] For the purpose of calculating

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[1] Interview with Safety-Kleen Co., Gray-Mills Co. and Kleer-Flo Co. personnel; these firms are manufacturers of cold solvent metal degreasing equipment.

[2] Based on information in EPA 450/2-77-022, op. cit., and interviews with Baron-Blakeslee and Detrex Chemical personnel.

cost impacts in this study, 35 percent was used. About 10 percent of conveyorized cleaners are expected to be exempt[1] and about 20 percent of cold cleaners.[2]

- Open top vapor degreasers with less than one square meter (10.8 square feet) air/vapor interface and conveyorized degreasers with less than two square meters (21.6 square feet) are to be exempt. This exemption applies to about 30 percent of open top cleaners and 5 percent of conveyorized degreasers.[1]

The guidelines leave open to the degreaser user the option of changing from a nonexempt solvent to an exempt one. In most cases, this will require some modification of the degreaser and an additional expense for the modification. In this study it was assumed that no substitution is made.

No reliable information has been found which relates size of cleaner with solvent composition. Therefore, we have assumed a uniform distribution of solvent composition with cleaner size, i.e., the number of small cleaners using exempt solvents is the same as the number of large cleaners using exempt solvents. For instance, the total of affected open top vapor degreasers in the state was determined by multiplying the total number of open top vapor degreasers in the state by the fractions that are nonexempt by solvent use and by size, i.e.:

Number exempt by size = (Total number of open top degreasers) x (Fraction exempt by size, 0.3)

Number exempt by solvent = (Total number of open top degreasers - number exempt by size) x (Fraction exempt by solvent, 0.35)

Total number of affected (nonexempt) degreasers = (Total number of open top degreasers) - (Number exempt by size) - (Number exempt by solvent)

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[1] Based on information in EPA 450/2-77-022, op. cit., and interviews with Baron-Blakeslee and Detrex Chemical personnel.

[2] Dow report, op. cit.

The resulting estimate of the total number of degreasers in the state and those exempt from the proposed regulations by size and solvent composition are summarized in Exhibit 11-3, in section 11.2.

11.1.4 Method of Estimation of Number and Type of Retrofitted Controls Needed

The proposed regulations specify certain controls which can be retrofitted to existing solvent metal cleaners. These are discussed in detail in a later section of this chapter. Briefly they are:

- For affected cold cleaners--
  - A cover must be installed when the solvent used has a volatility greater than 15 millimeters of mercury at 38°C, or is agitated, or the solvent is heated; and
  - An internal drainage facility (or, where that is not possible, an external closed drainage facility) must be installed, such that the cleaned parts drain while covered when the solvent used has a volatility greater than 32 millimeters of mercury at 38°C; and
  - Where the solvent has a volatility greater than 32 millimeters of mercury at 38°C, a freeboard must be installed that gives a freeboard ratio (i.e., distance from cleaner top to solvent surface divided by cleaner width) greater than or equal to 0.7; or a water cover where the solvent is heavier and immiscible or unreactive with water; or some other system of equivalent control.
- For affected open top vapor degreasers--
  - The vapor degreaser must be equipped with a cover; and
  - A spray safety switch must be installed which shuts off the spray pump when the vapor level drops more than 4 inches; and

    - If the freeboard ratio is greater than 0.75, a powered cover must be installed or a refrigerated chiller; or an enclosure in which a cover or door opens only when the dry part is entering or exiting the degreaser; or a carbon adsorption system; or an equivalent control system.

- For affected conveyorized degreasers--
    - A refrigerated chiller; or carbon adsorption system; or another equivalent control system must be installed; and
    - The cleaner must be equipped with a drying tunnel or rotating basket to prevent cleaned parts from carrying out solvent; and
    - A condenser flow switch and thermostat, a spray safety switch and a vapor high level control thermostat must be installed; and
    - Openings must be minimized during operation so that entrances and exits silhouette workloads; and
    - Downtime covers must be provided for closing off the entrance and exit during shutdown hours.

Exhibits 11-14, 11-15 and 11-16, of this chapter, summarize estimates of the percentage of non-exempt cleaners needing these controls. Equipment manufacturers were the primary source of the percentages used. In applying this information, it was assumed that the number and type of control needed were independent of size.

11.1.5 Method of Estimation of Current Emissions and Expected Reductions

Current VOC emissions from solvent metal degreasing and the reductions anticipated by the enforcement of the proposed regulations are based on information presented in Control of Volatile Organic Emissions from Solvent Metal Cleaning, EPA 450/2-77-022, November 1977. This report estimates average emissions for each type of degreaser. The total current emissions were obtained by multiplying these estimated average emissions by the number of each type of degreaser in the affected areas of the state.

The report also estimates the reduction in emissions possible by implementation of various types of controls. The methods proposed in recent EPA guidance can result in reduction of 50 percent to 69 percent for various types of degreasers. Emission levels which would result from implementation of the RACT proposals for solvent metal cleaners was obtained by use of these estimated reductions for the number of affected cleaners in the state. For purposes of estimation, a 50 percent reduction was used for cold cleaners. For open top vapor and conveyorized cleaners, a 60 percent reduction was used.

11.1.6 Method of Estimation of Compliance Costs

Compliance costs also were based primarily on the cost data presented in the EPA report, Control of Volatile Organic Emissions from Solvent Metal Cleaning, for average-sized, cold, open top vapor and conveyorized cleaners. These cost data, however, were verified by discussions with equipment manufacturers. Where some costs, such as for safety switches or downtime covers, were not estimated in the report, estimates were made based on further discussions with equipment manufacturers. In the EPA report, costs were presented for various retrofit control options; in each case the control which would provide minimum net annualized costs was used in the estimates made here. Other costs not presented in the EPA report were determined as follows:

- Safety switches, minimizing conveyorized cleaner openings, and downtime cover capital costs were estimated on the basis of discussions with equipment manufacturers. Costs used were:
    - $275 per manual cover and $100 per safety switch installation for open top vapor degreasers
    - $250 per safety switch installation, $300 per downtime cover installation, $2,500 per drying tunnel, and $1,000 for reducing openings for conveyorized cleaners.
- $300 was used as an average cost for increasing freeboard of cold cleaners using high volatility solvents.

- Annual capital charges were estimated as 25 percent of capital costs, to include depreciation, interest, maintenance, insurance and administrative costs.

- Labor costs for mounting downtime covers on conveyorized cleaners at shift end were estimated at $1,500 per year per cleaner.

- Additional costs which might result from decreased productivity, labeling and other requirements of the proposed regulations were assumed to be small and negligible.

11.1.7 Quality of Estimates

Several sources of information were utilized in assessing the emissions, direct compliance cost and economic impact of implementing RACT controls on plants using solvent metal degreasers in Georgia. A rating scheme is presented in this section to indicate the quality of the data available for use in this study. A rating of "A" indicates hard data, "B" indicates data that was not available in secondary literature and was extrapolated from hard data (i.e. data that is published for the base year) and "C" indicates data was estimated based on interviews, analyses of previous studies and best engineering judgement. Exhibit 11-1A, on the following page, rates each study output and overall quality of the data.

EXHIBIT 11-1A
U.S. Environmental Protection Agency
DATA QUALITY

Study Outputs	A "Hard Data"	B "Extrapolated Data"	C "Estimated Data"
Industry statistics	X	X	
Emissions		X	
Cost of emissions control		X	X
Statewide costs of emissions			X
Overall quality of data		X	

Source: Booz, Allen & Hamilton Inc.

11.2 INDUSTRY STATISTICS

This section summarizes an estimation of the total number of solvent metal cleaners affected in the state determined by the methods discussed in section 11.1.2 of this report. These estimates include only the 12 county non-attainment areas of Georgia. Additionally the proposed regulations would apply to solvent metal cleaning operations in the state if the potential VOC emissions from the facility are over 100 tons annually. Although no facilities were identified from State Emission Inventory with VOC emmissions over 100 tons from Solvent Metal Cleaning operations, there may be a few facilities affected in the state outside the 12 county area studied. As shown in Exhibits 11-1 and 11-2, on the following pages, a total of 96 open top vapor degreasers, 24 conveyorized degreasers and 9,185 cold cleaners are estimated to be in use in Georgia in manufacturing, maintenance or service. As discussed earlier, not all of these will be subject to RACT regulations because of size or solvent exemptions. About 30 percent of open top vapor degreasers, 5 percent of conveyorized degreasers and 70 percent of cold cleaners are expected to be exempt on the basis of size. About 35 percent of open top vapor degreasers, 10 percent of conveyorized degreasers and 20 percent of cold cleaners are expected to be exempt because they use exempt solvents 1,1,1-trichloroethane or Freon 113. Applying these factors results in the total of affected cleaners shown in Exhibit 11-3, following Exhibit 11-2.

It is difficult to estimate the number of establishments affected by the regulations, since a plant may have one or many cleaners of each type. In fact, large-scale users may have more than 100 degreasing operations in one plant location. Metal working industries would be major users; eight SIC codes, 25 and 33-39, cover these industries.

These classifications include such industries as automotive, electronics, appliances, furniture, jewelry, plumbing, aircraft, refrigeration, business machinery and fasteners. However, use of solvent cleaning is not limited to those industries, since many cleaners are used, for both manufacturing and maintenance, in nonmetal working industries such as printing, chemicals, plastics, rubber, textiles, paper and electric power. Also, most automotive, railroad, bus, aircraft, truck and electric motor repair stations use metal solvent cleaners at least part time.

EXHIBIT 11-1 (1)
U.S. Environmental Protection Agency
ESTIMATED NUMBER OF VAPOR DEGREASERS IN GEORGIA[e]
IN 12 COUNTY NON-ATTAINMENT AREA OF GEORGIA[e]

	SIC GROUP								
Item	25 Metal Furniture	33 Primary Metals	34 Fabricated Products	35 Nonelectrical Machinery	36 Electrical Equipment	37 Transptn. Equipment	38 Instruments and Clocks	39 Misc. Industry	Total
Number of Georgia plants with more than 19 employees[a]	31	20	80	63	33	24	11	25	287
Percent of U.S. plants using solvent degreasing[b]	46	40	42	52	55	50	65	39	
Percent of Georgia plants using solvent degreasing	44	38	40	50	53	48	62	37	
Number of Georgia plants using solvent degreasing	14	8	32	32	17	12	7	9	131
Percent of U.S. plants using vapor degreasing	48	42	41	33	67	43	62	56	
Percent of Georgia plants using vapor degreasing	40	35	34	27	55	36	51	46	
Number of Georgia plants using vapor degreasing	6	3	11	9	9	4	4	4	50
Average number of vapor degreasers per U.S. plant	1.98	2.21	1.62	1.61	2.03	3.25	2.27	1.02	
Average number of vapor degreasers per Georgia plant	1.76	1.96	1.44	1.43	1.80	2.88	2.01	0.90	
Number of Vapor degreasers in Georgia	11	6	16	13	16	12	8	4	86
Percent in U.S. as open top degreasers	73	79	79	81	87	87	94	89	

EXHIBIT 11-2

U.S. Environmental Protection Agency
ESTIMATED NUMBER OF COLD CLEANERS IN 12 COUNTY NON-ATTAINMENT AREA OF GEORGIA

	U.S.	Georgia
Total number of plants in SIC Groups 25,33,34,35,36,37,38,39[a]	125,271	765
Estimated number of cold cleaners in manufacturing[b]	390,000	2,382
Total number of plants in service industries SIC 551,554,557,7538,7539,7964[a]	227,350	1,871
Estimated number of cold cleaners in maintenance and service use[b,c]	910,000	6,803
Estimated total number of cold cleaners[a]	1,300,000	9,185

Notes:

a. Source: 1976 County Business Patterns, U.S. Department of Commerce, 1976.

b. Source: Control of Volatile Organic Emissions From Solvent Metal Cleaning, EPA-450/2-77-022, November 1977.

c. This includes cold cleaners in maintenance and service applications in both manufacturing and repair firms.

Source: Booz, Allen & Hamilton, Inc.

EXHIBIT 11-3
U.S. Environmental Protection Agency
ESTIMATE OF AFFECTED SOLVENT METAL CLEANERS IN GEORGIA
(12 County Non-Attainment Area)

Exemption	Number of Cleaners by Type		
	Cold	Open Top Vapor	Conveyorized
Total number of cleaners	9,185	96	24
Number exempt by size	6,430	29	1
Number affected by size	2,755	67	23
Number further exempted by type of solvent used	551	10	2
Total number of affected cleaners	2,204	57	21

Source: Booz, Allen & Hamilton Inc.

As shown in Exhibit 11-1, 131 establishments in the SIC codes 25 and 33-39, with more than 19 employees, are estimated to use solvent metal degreasing. However, as shown in Exhibit 11-2, following Exhibit 11-1, there are a total of 765 plants in SIC groups 25 and 33-39 and an additional 1,875 plants in service industries; all of these are expected to have some type of solvent degreasers and could be potentially affected.

11.2.1 Proposed Emission Control Systems for Solvent Metal Cleaners

The EPA has proposed two different emission control methods, A and B, for each of the three types of cleaners: cold, open top vapor and conveyorized. The control methods can be combined in various ways to form a number of alternative control systems. Generally, control system A consists of proper operating practices and simple, inexpensive control equipment. Control system B consists of system A plus other devices that increase the effectiveness of control. Elements of control systems A or B can be modified to arrive at the level of control needed. The control systems are presented in the three exhibits, Exhibit 11-4, 5 and 6, on the following pages, and are briefly discussed below. In general, use of control system B has been proposed to maximize emission reductions.

11.2.1.1 Cold Cleaning Control Systems

The most important emission control for cold cleaners is the control of waste solvent. The waste solvent needs to be reclaimed or disposed of so that a minimum evaporates into the atmosphere. Next in importance are the operating practices of closing the cover and draining cleaned parts. Several other control techniques become significant only in a small fraction of applications.

The difference in effect between systems A and B (Exhibit 11-4) is not large because most of the cold cleaning emissions are controlled in system A. If the requirements of system A were followed conscientiously by nearly all of the cold cleaning operators, there would be little need for the additional system B requirements. However, because cold cleaning operators tend to be lax in keeping the cover closed, equipment requirements #1 and #4 in system B are added. Similarly, the modifications for #2 and the equipment requirements in #3 would effect significant emission reductions in a few applications.

The effectiveness of the control systems depends greatly on the quality of operation. On the average, system A is estimated to be able to reduce cold cleaning emissions by 50 (± 20) percent and system B may reduce it by 53 (± 20) percent. The low end of the range represents the emission reduction projected for poor compliance, and the high end represents excellent compliance. The expected benefit from system B is only slightly better than that for

EXHIBIT 11-5(1)
U.S. Environmental Protection Agency
EPA PROPOSED CONTROL SYSTEMS FOR OPEN TOP VAPOR DEGREASERS

Control System A

Control Equipment:

1. Cover that can be opened and closed easily without disturbing the vapor zone.

Operating Requirements:

1. Keep cover closed at all times except when processing work loads through the degreaser.

2. Minimize solvent carry-out by the following measures:

a. Rack parts to allow full drainage.
b. Move parts in and out of the degreaser at less than 3.3 m/sec (11 ft/min).
c. Degrease the work load in the vapor zone at least 30 sec. or until condensation ceases.
d. Tip out any pools of solvent on the cleaned parts before removal.
e. Allow parts to dry within the degreaser for at least 15 sec. or until visually dry.

3. Do not degrease porous or absorbent materials, such as cloth, leather, wood or rope.

4. Work loads should not occupy more than half of the degreaser's open top area.

5. The vapor level should not drop more than 10 cm (4 in) when the work load enters the vapor zone.

6. Never spray above the vapor level.

7. Repair solvent leaks immediately, or shut down the degreaser.

8. Do not dispose of waste solvent or transfer it to another party such that greater than 20 percent of the waste (by weight) will evaporate into the atmosphere. Store waste solvent only in closed containers.

9. Exhaust ventilation should not exceed 20 m^3/min per m^2 (65 cfm per ft^2) of degreaser open area, unless necessary to meet OSHA requirements. Ventilation fans should not be near the degreaser opening.

10. Water should not be visually detectable in solvent exiting the water separator.

Control System B

Control Equipment:

1. Cover (same as in system A).

2. Safety switches

a. Condenser flow switch and thermostat - (shuts off sump heat if condenser coolant is either not circulating or too warm).

b. Spray safety switch - shuts off spray pump if the vapor level drops excessively, about 10 cm (4 in).

EXHIBIT 11-5 (2)
U.S. Environmental Protection Agency

3. Major Control Device:

Either: a. Freeboard ratio greater than or equal to 0.75, and if the degreaser opening is $1m^2$ ($10\ ft^2$), the cover must be powered,

b. Refrigerated chiller,

c. Enclosed design (cover or door opens only when the dry part is actually entering or exiting the degreaser),

d. Carbon adsorption system, with ventilation 15 m^3/min per m^2 (50 cfm/ft^2) or air/vapor area (when cover is open), and exhausting 25 ppm solvent averaged over one complete adsorption cycle, or

e. Control system, demonstrated to have control efficiency, equivalent to or better than any of the above.

4. Permanent, conspicuous label, summarizing operating procedures #1 to #6.

Operating Requirements:

Same as in System A.

Source: EPA-450/2-77-022, op. cit.

system A for an average cold cleaner because the additional devices required in system B generally control only bath evaporation, about 20 to 30 percent of the total emission from an average cold cleaner. For cold cleaners with high volatility solvents, bath evaporation may contribute about 50 percent of the total emission; EPA estimates that system B could achieve 69 (± 20) percent control efficiency, whereas system A might achieve only 55 (± 20) percent.

11.2.1.2 Open Top Vapor Degreasing Control Systems

The basic elements of a control system for open top vapor degreasers are proper operating practices and use of control equipment. There are about ten main operating practices. The control equipment includes a cover, safety switches and a major control device, either high freeboard, refrigerated chiller, enclosed design or carbon adsorption as outlined in Exhibit 11-5.

A vapor level thermostat is not included because it is already required by OSHA on "open surface vapor degreasing tanks." Sump thermostats and solvent level controls are used primarily to prevent solvent degradation and protect the equipment and thus are also not included here. The emission reduction by these controls is a secondary effect in any event. The two safety switches serve primarily to reduce vapor solvent emissions.

EPA estimates that system A may reduce open top vapor degreasing emissions by 45 (± 15) percent, and system B by 60 (± 15) percent. For an average-sized open top vapor degreaser, systems A and B would reduce emissions from 9.5 m tons/year down to about 5.0 and 3.8 m tons/year, respectively. It is clear that system B is appreciably more effective than system A.

11.2.1.3 Conveyorized Degreasing Control Systems

Control devices tend to work most effectively on conveyorized degreasers, mainly because they are enclosed. Since these control devices can usually result in solvent savings, they often will net an annualized profit. Two control systems for conveyorized degreasers as recommended by EPA are in Exhibit 11-6. Control system A requires only proper operating procedures which can be implemented, in most cases, without large capital expenditures. Control system B, on the other hand, requires a major control device.

Major control devices can provide effective and economical control for conveyorized degreasers. A refrigerated chiller will tend to have a high control efficiency, because room drafts generally do not disturb the cold air blanket. A carbon adsorber also tends to yield a high control efficiency, because collection systems are more effective and inlet streams contain higher solvent concentrations for conveyorized degreasers than for open top vapor degreasers.

11.2.2 Emissions and Expected Emission Reduction

In Exhibit II-7, on the following page, are summarized the average emissions from solvent metal degreasers by type and also the percent emission reduction expected by implementation of Type B method of controls on nonexempt degreasers. The levels are based on estimated emissions as presented in the previously referenced EPA report (EPA 450/2-77-022) and represent current average emission levels and expected reductions achievable if emission controls are rigorously enforced. For estimation, 50 percent reduction was used for cold cleaners and 60 percent for open top vapor and conveyorized degreasers.

Exhibit 11-8, following Exhibit 11-7, presents the estimated current emissions from solvent metal degreasing and the expected emissions if the B methods of control are implemented for metal cleaners and proposed exemptions for size and type of solvent are implemented. As shown, emissions are expected to be reduced from about 4,800 short tons per year to a total of 3,700 short tons per year. The major portion of these reduced emissions, 2,822 tons, are from solvent metal cleaners exempt from the proposed RACT regulations either by size or by the nature of solvent used. Implementation of the regulations will reduce emissions by 1,100 tons per year (4,800-3,700).

EXHIBIT 11-7
U.S. Environmental Protection Agency
AVERAGE UNIT EMISSION RATES AND EXPECTED EMISSION REDUCTIONS

EMISSION RATES WITHOUT CONTROLS

Type of Degreaser	Averaged Emission Rate Per Unit (short tons/yr.)
Cold cleaners, batch [a]	0.33
Open top vapor degreaser	11.00
Conveyorized degreaser	29.70

PERCENT EMISSION REDUCTION EXPECTED WITH TYPE B CONTROLS

Type of Degreaser	Percent Emission Reduction Expected
Cold cleaner, batch	
Low volatility solvents	53 (± 20)
High volatility solvents	69 (± 20)
Open top vapor degreaser	60 (± 15)
Conveyorized degreaser	60 (± 15)

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[a] Does not include emissions from conveyorized-type cold cleaners which represent about 15 percent of all conveyorized cleaners.

Source: EPA-450/2-77-022, op. cit.

EXHIBIT 11-8

U.S. Environmental Protection Agency

ESTIMATED CURRENT AND REDUCED EMISSIONS FROM SOLVENT METAL CLEANING IN GEORGIA

(12 County Non-Attainment Area)[b]

Type of Cleaner	Estimated Current Emissions	Estimated Emissions From Nonexempt Cleaners After RACT	Estimated Emissions From Exempt Cleaners After RACT[a]	Estimated Total Emissions After RACT[a]
Open top vapor	1,056	250	429	679
Conveyorized	713	249	89	338
Cold	3,031	364	2,304	2,668
Total	4,800	863	2,822	3,685

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a. Includes emissions from cleaners exempt by size or using 1,1,1-trichloroethane or Freon 113

Source: Booz, Allen & Hamilton Inc.

11.3 ESTIMATED COSTS OF RACT IMPLEMENTATION

As discussed in Section 11.1.6 compliance costs are based upon EPA estimates of the costs and benefits of various retrofitted methods of control. These estimates are summarized in Exhibits 11-9 and 11-10, on the following pages.

Costs of implementation of the RACT regulations are summarized in Exhibits 11-11, 11-12 and 11-13 on the assumption that control methods B are used to maximize emission reduction on nonexempt cleaners. Exhibits 11-14, 11-15, and 11-16 summarize the number and type of controls needed by cleaner type as determined from interviews with cleaner manufacturers. Total expenditures for all cleaners, vapor and cold types, are estimated to be about $1.1 million in capital and about $0.14 million in net annualized costs. The low net annualized costs result primarily from the savings in solvent use which the regulations are expected to provide.

In no case are the regulations expected to present a severe financial burden to individual firms. The largest single expenditure would be for retrofitting a monorail conveyorized degreaser with chiller, switches, drying tunnel, reduced openings and downtime covers. Total cost for an average-sized degreaser of about 3.8 square meters area (40.9 ft^2) would be less than $12,500. A large unit, 14 square meters, would cost about $27,000 to $30,000. Since these conveyorized systems would only be used in large plants with large sales volumes, this implementation cost is not expected to present a hardship to any particular firm.

EXHIBIT 11-9
U.S. Environmental Protection Agency
CONTROL COSTS FOR COLD CLEANER WITH 5.25 $ft.^2$ AREA

Item	Low Volatility Solvent[a]	High Volatility Solvent[b]
Installed capital ($)	25.00	365.00
Direct operating costs ($/yr.)	1.00	2.6
Capital related charges ($/yr.)[c]	4.30	91.25
Solvent cost (credit) ($/yr.)	(4.80)	(39.36)
Annualized cost (credit) ($/yr.)	0.50	54.49

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a. Costs include only a drainage facility for low volatility solvents.

b. Includes $65 for drainage facility, a mechanically assisted cover, and $300 for extension of freeboard.

c. Capital charges used in study estimate were 25 percent of capital instead of 17 percent used in EPA report.

Source: EPA-450/2-77-022, op. cit.

EXHIBIT 11-10
U.S. Environmental Protection Agency
CONTROL COSTS FOR AVERAGE-SIZED
OPEN TOP VAPOR AND CONVEYORIZED CLEANERS

1. CONTROL COSTS FOR TYPICAL SIZE OPEN TOP VAPOR DEGREASER
(Vapor to Air Area of 1.67 m^2)

Control Technique	Manual Cover	Carbon Adsorption[a]	Refrigerated Chiller	Extended Freeboard & Powered Cover
Installed capital ($)	300	10,300	6,500	8,000
Direct operating cost ($/yr.)	10	451	259	100
Capital related charges ($/yr.)	75	2,575	1,625	2,000
Solvent cost (credit) ($/yr.)	(860)	(1,419)	(1,290)	(1,161)
Net annualized cost (credit) ($/yr.)	(775)	1,607	594	939

2. CONTROL COSTS FOR TYPICAL CONVEYORIZED DEGREASERS
(Vapor to Air Vapor Area of 3.8 m^2)

	Monorail Degreaser		Crossrod Degreaser	
Control Technique	Carbon[a] Adsorber	Refrigerated Chiller	Carbon[a] Adsorber	Refrigerated Chiller
Installed capital ($)	17,600	8,550	17,600	7,460
Direct operating costs ($/yr.)	970	430	754	334
Capital related charges ($/yr.)				
Capital charges ($/yr.)[b]	4,400	2,138	4,400	1,865
Solvent cost (credit) ($/yr.)	(5,633)	(5,633)	(2,258)	(2,258)
Annualized cost (credit) ($/yr.)	(263)	(3,065)	2,896	(59)

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a. Not used in cost estimates since net annualized costs for carbon absorption are the highest for any control method.

b. Capital charges used in study estimate were 25 percent of capital instead of 17 percent used by EPA source.

Source: EPA 450/2-77-022, op. cit.

EXHIBIT 11-11
U.S. Environmental Protection Agency
ESTIMATED CONTROL COSTS FOR COLD CLEANERS
FOR THE STATE OF GEORGIA
(12 County Non-Attainment Area)

1. CAPITAL COSTS

Item	Number of Degreasers Needing Conversion	Costs
Capital	1,499	$509,735

2. ANNUALIZED COSTS

Item	Costs
Direct operating costs	$ 3,721
Capital related charges	127,434
Solvent cost	(55,199)
Net annualized costs	$ 75,956

Source: Booz, Allen & Hamilton, Inc.

EXHIBIT 11-12
U.S. Environmental Protection Agency
ESTIMATED CONTROL COSTS FOR OPEN TOP VAPOR DEGREASERS FOR THE STATE OF GEORGIA
(12 County Non-Attainment Area)

1. CAPITAL COSTS

Item	Cost
Safety switches	$ 1,700
Powered covers	408,000
Manual covers	5,100
Total	$414,800

2. ANNUALIZED COSTS

Item	Cost
Direct operating costs	$ 5,270
Capital related charges	103,700
Solvent cost	(73,831)
Net annualized costs	$ 35,139

Source: Booz, Allen & Hamilton, Inc.

EXHIBIT 11-13
U.S. Environmental Protection Agency
ESTIMATED CONTROL COSTS FOR CONVEYORIZED DEGREASERS FOR THE STATE OF GEORGIA
(12 County Non-Attainment Area)

1. CAPITAL COSTS

Item	Costs
Refrigerator chiller	
Monorail degreasers	$ 68,400
Crossrod degreasers	82,060
Safety switches	1,000
Drying tunnel	5,000
Reduce openings	19,000
Downtime covers	5,700
Total	$181,160

2. ANNUALIZED COSTS

Item	Costs
Direct operating costs	$ 35,614
Capital related charges	45,290
Solvent cost	(47,322)
Net annualized cost	$ 33,582

Source: Booz, Allen & Hamilton, Inc.

EXHIBIT 11-14
U.S. Environmental Protection Agency
ESTIMATED NUMBER OF COLD CLEANERS NEEDING CONTROLS IN THE STATE OF GEORGIA (12 County Non-Attainment Area)

Type of Control	Estimated Percent of Cleaners Needing Control	Estimated Number of Cleaners Needing Control
Drainage Facility[a]	5	110
Freeboard and Drainage[b]	63	1,389

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a. Based on 10 percent of cleaners using low volatility solvents and half of these needing drainage facilities.

b. Based on 90 percent of cleaners using high volatility solvents and 70 percent of these needing additional freeboard and drainage.

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 11-15

U.S. Environmental Protection Agency ESTIMATED NUMBER OF OPEN TOP VAPOR DEGREASERS NEEDING CONTROL IN THE STATE OF GEORGIA (12 County Non-Attainment Area)

Type of Control	Estimated Percent of Cleaners Needing Control	Estimated Number of Cleaners Needing Control
Manual covers	30	17
Safety switches	20	11
Powered cover	90	51

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 11-16

U.S. Environmental Protection Agency

ESTIMATED NUMBER OF CONVEYORIZED DEGREASERS NEEDING CONTROLS IN THE STATE OF GEORGIA

(12 Non-Attainment Counties)

Type of Control	Percent of Cleaners Needing Control	Number of Cleaners Needing Control
Refrigerated chillers for monorail and miscellaneous type cleaners[a]	36	8
Refrigerated chillers for crossrod type cleaners	54	11
Safety switches	20	4
Drying tunnel	10	2
Minimized openings	90	19
Downtime covers	90	19

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[a] Refrigerated chillers were estimated to be needed only on about 90 percent of all conveyorized vapor degreasers; thus, the percent of units needed by monorail-miscellaneous and crossrod types add only to 90 percent.

Source: Booz, Allen & Hamilton Inc.

11.4 DIRECT ECONOMIC IMPLICATIONS

11.4.1 Time Required To Implement Proposed RACT Regulations

Because many degreasers are affected under the proposed regulation (57 open top vapor degreasers, 21 conveyorized degreasers and 2,204 cold cleaners in Georgia alone) and because each requires retrofitting of a control device, some users may not be able to comply within proposed compliance schedules because of equipment availability. Discussions with personnel from the major manufacturers of vapor and cold degreasers reveal that none are prepared to provide the necessary controls in quantities to meet a cumulative U.S. wide demand. Some cleaners could be converted to 1,1,1-trichloroethane and thus become exempt. In fact, many metal solvent cleaners have been converted to trichloroethane in the last few years in anticipation of RACT regulations. However, not all existing machines can be converted because of inadequate condensing sections or improper materials of construction. Trichloroethane can be extremely corrosive if stabilizers are insufficiently replenished. In fact, stainless steel vapor degreasers using 1,1,1-trichloroethane have been reported to fail because of corrosion following the loss of stabilizer.

11.4.2 Effect of Compliance Upon Selected Economic Indicators

Implementation of the proposed regulations is expected to have a negligible effect on Georgia's statewide economy. Low capital and annual operating costs required by the solvent metal cleaner owners in meeting the proposed regulations are responsible for this minimal impact.

For example, Georgia's estimated total capital expenditures in non-attainment counties for SIC groups 25 and 33-39 exceed $75 million for 1976. Total capital expenditures for retrofitting are estimated to be $1.1 million for all SIC groups in non-attainment counties, less than one percent of total capital expenditures for these counties.

Similarly implementation will have a negligible impact on total shipments, prices and the state economy as a whole. The total net annual operating costs of the proposed regulations ($0.14 million) are negligible compared to the 1976 total shipments of $3.6 billion in SIC groups 25 and 33-39. Considering that these expenditures are spread over service industries and other industries not included in SIC's 25 and 33-39, the overall economic impact is even less significant.

Although solvent metal cleaners are particular to certain industries the proposed regulations are expected to not have an impact on the structure of the state industry. This is due to the dispersion of solvent metal cleaners over many industries and the minimal importance of solvent metal cleaning to the manufacturing processes.

Implementation of the regulations will reduce demand for metal cleaning solvents. This would result in a reduction in solvent sales of about $0.2 million annually which may result in a loss of employment for firms supplying metal cleaning solvents.

11.4.3 Effect of Compliance Upon Energy Consumption

Carbon adsorbers, refrigerated chillers and distillation units are the principal energy consuming control devices used for controlling degreasing emissions. The refrigerated chiller, which would probably be the preferred method of control because of its low capital and operating costs, will increase a degreaser's energy consumption by about 5 percent. The EPA has estimated consumption of 0.2 kw to 2.2 kw by a chiller, used on a typical open top vapor degreaser of $1.7m^2$ size.[1] For a typical conveyorized degreaser of about $3.8m^2$ size, consumption is estimated, on this basis, to be 0.5 kw to 5.0 kw. Only conveyorized degreasers are expected to use chillers to comply; and about 90 percent or 19 of these currently do not have chillers. Assuming 2,250 hours per year operation, total additional energy consumption annually would be about 21,300 kw-hours to 213,000 kw-hours. This is equal to $852 to $8,520 per year in additional power costs, at a cost of $0.04 per kw-hour. Most of this cost is recovered by savings in solvent use. A portion of the increase in energy consumption will be offset by reduced production and consumption of solvents; production because it takes energy to produce solvents and consumption because there is embodied energy in feedstocks such as petroleum distillates.

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[1] EPA-450/2-77-022, op. cit.

11.5 SELECTED SECONDARY ECONOMIC IMPACTS

Implementation is also expected to have minor, if not negligible, impact upon other factors, such as employment, market structure and productivity. The proposed regulations include some change in work practices which will decrease productivity in the metal cleaning operation by 5 percent to 10 percent. Since metal cleaning is normally a minor step in the manufacturing or service process, any change in productivity and employment in user plants is expected to be insignificant.

There will, however, be some temporary increase in employment by those firms manufacturing such components as refrigeration chillers and drying tunnels, that may be required for retrofit controls. No estimates have been made because manufacturers of such components are located throughout the country. This temporary increase, however, may be balanced by a slight decrease in employment occurring because of lower solvent consumption. The decrease would occur primarily in shipping and repackaging operations.

The implementation of the RACT guidelines should not have any major affect on the current market structure of the industries using solvent metal cleaning. Cleaners requiring highest retrofitting costs (i.e., for conveyorized cleaners) are generally owned by large firms. Smaller firms would be expected to have only cold cleaners or open top vapor degreasers. The highest capital costs would be for an open top unit which would require an expenditure of $8,000 or less to comply. This is not expected to be a significant financial burden even to small-sized firms.

* * * *

Exhibit 11-17, on the following page, summarizes the conclusions presented in this report.

EXHIBIT 11-17
U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR SOLVENT METAL DEGREASING IN THE STATE OF GEORGIA[1]

Current Situation	Discussion
Number of potentially affected facilities	About 2,300 plants.
Indication of relative importance of industrial section to state economy	Value of shipments of firms in SIC groups affected for nonattainment counties is in the range of 3.6 billion, about 40% of the state total for these SIC groups.
Current industry technology trends	Where technically feasible, firms are substituting exempt solvent.
1977 VOC emissions (actual)	4,800 tons/year. (Including solvents classified as exempt)
Industry preferred method of VOC control to meet RACT guidelines	Substitution. Otherwise lowest cost option as specified by EPA will be used.
Assumed method of VOC control to meet RACT guidelines	Equipment modifications as specified by the RACT guidelines.

Affected Areas in Meeting RACT	Discussion
Capital investment (statewide)	$1.1 million.
Annualized cost (statewide)	$0.14 million, (less than 0.01 percent of the 1977 affected facilities value of shipments).
Price	Metal cleaning is only a fraction of manufacturing costs; price effect expected to be less than 0.01 percent for affected facilities.
Energy	Less than 150 equivalent barrels of oil per year increase.
Productivity	5-10 percent decrease for manually operated degreasers. Will not affect conveyorized cleaners.
Employment	No effect except a possible slight decrease in firms supplying metal degreasing solvents.
Market structure	No change.
RACT timing requirements (1982)	Equipment availability--only a few companies now supply the recommended control modifications.
Problem Areas	No significant problem areas seen. Most firms will be able to absorb cost.
VOC emission after RACT control	3,700 tons/year (11 percent of 1977 VOC emission level--however, this does not include emission controls for exempt solvents.)
Cost effectiveness of RACT control	$127 annualized cost per ton of emissions reduced.

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1. These estimates were computed for nonattainment counties only. These were Clayton, Columbus, Cobb, Coweta, DeKalb, Douglas, Fayette, Fulton, Gwinett, Henry, Paulding and Rockdale. The proposed regulation would also apply to solvent metal cleaning operations in facilities with potential VOC emissions over 100 tons annually outside the 12 county nonattainment area. Although no facilities outside the nonattainment areas were identified, there may be some affected in the state by the proposed regulations.

Source: Booz, Allen & Hamilton, Inc.

BIBLIOGRAPHY

U.S. Department of Commerce, County Business Patterns, 1976.

U.S. Department of Commerce, Census of Manufactures, 1972.

U.S. Environmental Protection Agency, Control of Volatile Organic Emissions from Solvent Metal Cleaning EPA-450/2-77-002, November 1977.

U.S. Environmental Protection Agency, Regulatory Guidance for Control of Volatile Organic Emissions from 15 Categories of Stationary Sources. EPA-905/2-78-001, April 1978.

Dow Chemical Company, Study to Support New Source Performance Standards for Solvent Metal Cleaning Operations. EPA Contract 68-02-1329, June 30, 1976.

Private conversations with the following:

Dextrex Chemical Company, Detroit, Michigan
Ethyl Corporation
DuPont
Dow Chemical Company
PPG
Allied Chemical Company
R.R. Street
Baron Blakeslee Corporation, Cicero, Illinois

13.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT FOR TANK TRUCK GASOLINE LOADING TERMINALS IN THE STATE OF GEORGIA

This chapter presents a detailed analysis of the impact of implementing RACT controls for tank truck gasoline loading terminals affected by proposed regulations in the State of Georgia. The chapter is divided into six sections including:

- Specific methodology and quality of estimates
- Industry statistics
- The technical situation in the industry
- Cost and VOC reduction benefit evaluations for the most likely RACT alternatives
- Direct economic implications
- Selected secondary economic impacts.

Each section presents detailed data and findings based on the RACT guidelines, previous studies of tank truck gasoline loading terminals, interviews, and analysis. Tank truck gasoline loading terminals in the State of Georgia, for purposes of this report, refer to those terminals affected by proposed state regulations.[1]

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[1] Terminals located in the following counties: Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Fulton, Swinnett, Henry, Muscogee, Paulding and Rockdale Counties, and all other terminals in the state which emit 100 tons or more of VOC's per year.

13.1 SPECIFIC METHODOLOGY AND QUALITY OF ESTIMATES

This section describes the methodology for determining estimates of:

- Industry statistics
- VOC emissions
- Processes for controlling VOC emissions
- Cost of controlling VOC emissions
- Economic impact of emission control

for affected tank truck gasoline loading terminals in the State of Georgia.

An overall assessment of the quality of the estimates is detailed in the latter part of this section.

13.1.1 Industry Statistics

Industry statistics on affected tank truck gasoline loading terminals were obtained from the Georgia Department of Natural Resources, Environmental Protection Division and the 1972 Census of Wholesale Trade, Petroleum Bulk Stations and Terminals. All data are presented in a base year, 1977, based on the following specific methodologies:

- The number of establishments in Georgia for 1977 was provided by the Georgia Department of Natural Resources Environmental Protection Division.

- The number of employees in the terminals in 1977 was estimated by determining the number of employees per establishment in 1972 (reported in the 1972 Census of Wholesale Trade, Petroleum Bulk Stations and Terminals) and multiplying this ratio by the number of facilities in 1977.

- The number of gallons of gasoline sold from affected terminals in 1977 in the State of Georgia was estimated from the gasoline throughput reported by the Georgia Department of Natural Resources, Environmental Protection Division.

- Sales, in dollars, of motor gasoline for 1977 were estimated by multiplying the number of gallons of gasoline sold in 1977 by the national dealer tank-wagon price in 1977 (42.5¢/gallon), which was reported in the National Petroleum News Fact Book, 1978.

13.1.2 VOC Emissions

VOC emissions for tank truck gasoline loading terminals in Georgia were estimated based on data provided by the Georgia Department of Natural Resources, Environmental Protection Division. Emissions were calculated using U.S. EPA emissions factors.

13.1.3 Processes for Controlling VOC Emissions

Processes for controlling VOC emissions for tank truck gasoline loading terminals are described in Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals, EPA-450/2-77-026. These data provide the alternatives available for controlling VOC emissions from tank truck gasoline loading terminals. Several studies of VOC emission control were also analyzed in detail, and interviews with petroleum trade associations, terminal operators and vapor control equipment manufacturers were conducted to ascertain the most likely types of control processes which would be used in terminals in Georgia. The specific studies analyzed were: Demonstration of Reduced Hydrocarbon Emissions from Gasoline Loading Terminals, PB-243 363; Systems and Costs to Control Hydrocarbon Emissions from Stationary Sources, PB-236 921; and The Economic Impact of Vapor Control in the Bulk Storage Industry, draft report to U.S. EPA by Arthur D. Little.

The alternative types of vapor control equipment likely to be applied to tank truck gasoline loading terminals were analyzed. Model plants reflecting each control alternative were defined and each type of control alternative used was applied to the number of tank truck gasoline loading terminals in the state. The methodology for the cost analysis of VOC emissions is described in the following paragraphs.

13.1.4 Cost of Vapor Control Systems

The costs of vapor control systems were developed by:

- Determining the alternative types of control systems likely to be used
- Estimating the probable use of each type of control system
- Defining systems components

- Developing installed capital costs for systems components
- Aggregating installed capital costs for each alternative control system
- Defining two model terminals based on throughput levels
- Developing costs of the alternative control systems for the two model terminals including:
    - Installed capital cost
    - Direct operating costs
    - Annual capital charges
    - Gasoline credit
    - Net annual cost
- Assigning model terminal costs to terminals in Georgia
- Aggregating costs to the total industry in Georgia.

Costs were determined mainly from analyses of the RACT guidelines and from interviews with petroleum marketers' associations, terminal operators and vapor control equipment manufacturers.

13.1.5 Economic Impact

The economic impacts were determined by analyzing the lead time requirements needed to implement RACT; assessing the feasibility of instituting RACT controls in terms of capital availability and equipment availability; comparing the direct costs of RACT control to various state economic indicators; and assessing the secondary effects on market structure, employment and productivity as a result of implementing RACT controls in Georgia.

13.1.6 Quality of Estimates

Several sources of information were utilized in assessing the emissions, cost and economic impact of implementing RACT controls on tank truck gasoline loading terminals in Georgia. A rating scheme is presented in this section to indicate the quality of the data available for use in this study. A rating of "A" indicates hard data (i.e., data that were published for the base year); "B" indicates data that were extrapolated from hard data; and "C" indicates data that were not available in secondary literature and were estimated based on interviews, analyses of previous studies and best engineering judgement. Exhibit 13-1, on the following page, rates each study output listed and the overall quality of the data.

Exhibit 13-1
U.S. Environmental Protection Agency
DATA QUALITY

Study Outputs	A Hard Data	B Extrapolated Data	C Estimated Data
Industry statistics	●		
Emissions		●	
Cost of emissions control		●	
Statewide costs of emissions			●
Economic impact			●
Overall quality of data		●	

Source: Booz, Allen & Hamilton, Inc.

13.2 INDUSTRY STATISTICS

Industry characteristics, statistics and business trends for tank truck gasoline loading terminals in Georgia are presented in this section. The discussion includes a description of the the number of facilities and their characteristics, a comparison of the size of the gasoline terminal industry to state economic indicators, a historical characterization and description of the industry and an assessment of future industry patterns. Data in this section form the basis for assessing the impact on this industry of implementing RACT on affected tank truck gasoline loading terminals in Georgia.

13.2.1 Size of the Industry

There were an estimated 33 potentially affected tank truck gasoline loading terminals, as of 1977, in Georgia. Industry sales were in the range of $2.8 billion, with an estimated yearly throughput of 6.54 billion gallons of gasoline. The estimated number of employees in 1977 was 520. These data and the sources of information are summarized in Exhibit 13-2, on the following page. Annual capital investments have not been estimated. In general, tank truck gasoline loading terminal investments are for plant and equipment to replace worn-out facilities, modernize the establishments or improve operating efficiencies.

13.2.2 Comparison of the Industry to the State Economy

A comparison of the affected tank truck gasoline loading terminal industry to the economy of the State of Georgia is shown in this section by comparing industry statistics to state economic indicators. Employees in the tank truck gasoline loading terminal industry represent 0.02 percent of the total state civilian labor force of Georgia. The value of gasoline sold from terminals represented approximately 18 percent of the total value of wholesale trade in Georgia in 1977.

13.2.3 Characterization of the Industry

Tank truck gasoline loading terminals are the primary distribution point in the petroleum product market network as shown in Exhibit 13-3, following Exhibit 13-2. Terminals

Exhibit 13-2

U.S. Environmental Protection Agency

INDUSTRY STATISTICS FOR BULK GASOLINE PLANTS IN GEORGIA

Number of Establishments	Number of Employees	Sales ($ Billion, 1977)	Gasoline Sold (Billions of Gallons)
33[a]	520[b]	2.8[c]	6.546[a]

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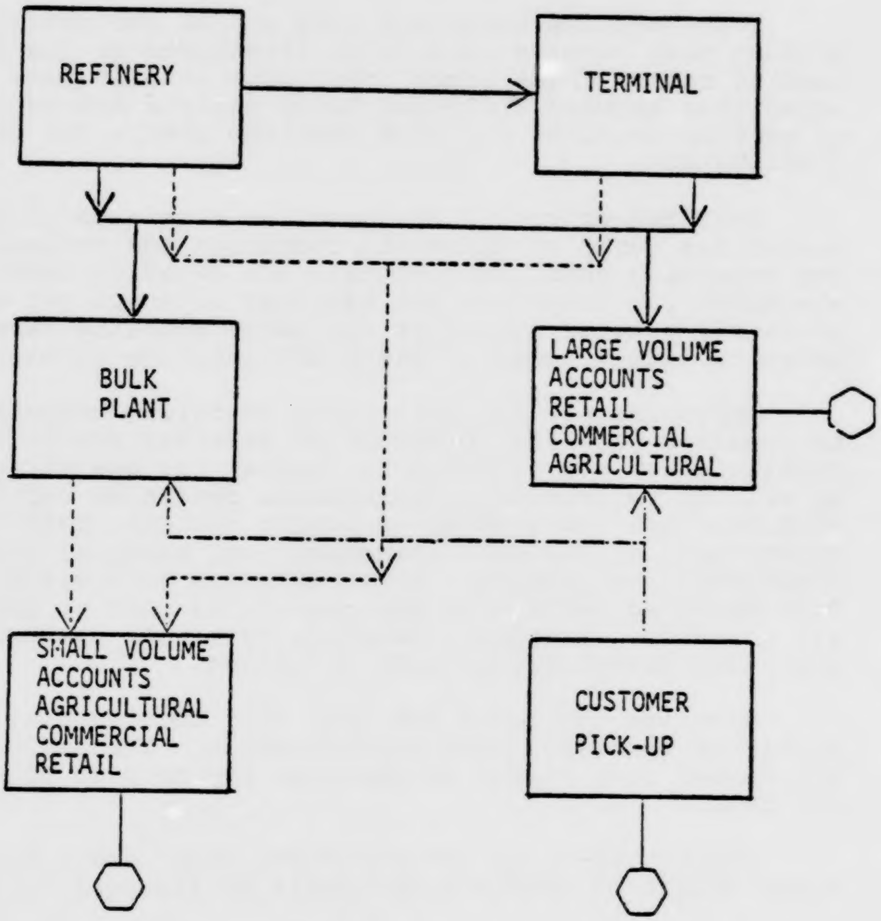
a. Georgia Department of Natural Resources Environmental Protection Division.

b. Booz, Allen & Hamilton Inc. estimate based on the ratio of the number of employees to the number of establishments in 1972.

c. Number of gallons of motor gasoline sold in 1977 multiplied by the national dealer tankwagon price in 1977 (42.51¢/gallon).

Source: Booz, Allen & Hamilton Inc.

Exhibit 13-3
U.S. Environmental Protection Agency
GASOLINE DISTRIBUTION NETWORK


REFINERY
TERMINAL
BULK PLANT
LARGE VOLUME ACCOUNTS RETAIL COMMERCIAL AGRICULTURAL
SMALL VOLUME ACCOUNTS AGRICULTURAL COMMERCIAL RETAIL
CUSTOMER PICK-UP

——→	Typical delivery route of truck-trailer
– – – →	Typical delivery route of account truck
–·–·–·→	Typical transaction with consumer coming to supplier
⬡	Final Product Usage

Source: Economic Analysis of Vapor Recovery Systems on Small Bulk Plants, EPA 240/1-77-013, September 1976, p. 3-2.

receive gasoline from refineries by pipeline, tanker or barge.

Most gasoline terminals load all of the petroleum product they receive into truck transports at the terminals' loading racks. These truck transports usually have storage capacities between 8,000 and 9,000 gallons and deliver gasoline to service stations and bulk gasoline plants for further distribution.

Over two-thirds of the gasoline terminals in the United States are owned by major oil companies and refiner/marketers. The remaining gasoline terminals are owned by independents. The major oil companies and regional refiners own a proportionately greater number of the large gasoline terminals and proportionately fewer of the small gasoline terminals.

Approximately ten years ago, petroleum companies began to consider gasoline terminals as separate profit centers. Terminals are now expected to recover all operating expenses as well as to provide an acceptable return on capital. Since terminals are now treated as profit centers, petroleum marketers have closed many uneconomic and marginal facilities throughout the country. Some marketers have withdrawn from selected regions of the country as part of their overall corporate strategy. Gasoline terminals in these markets are being consolidated, sold or closed.

Gasoline terminals are generally located near refineries, pipelines and large metropolitan areas. The daily throughput ranges from 20,000 gallons per day to over 600,000 gallons per day.

Exhibit 13-4, on the following page, shows an estimated distribution of gasoline terminals by throughput in Georgia.

Exhibit 13-4

U.S. Environmental Protection Agency

DISTRIBUTION OF TANK TRUCK GASOLINE LOADING TERMINALS BY AMOUNT OF THROUGHPUT IN THE UNITED STATES

Gasoline Throughput (gallons per day)	Percentage of Plants
Less than 200,000	30
200,000 to 399,000	27
400,000 to 599,000	10
Over 600,000	33
Total	100

Source: Georgia Department of Natural Resources, Environmental Protection Division.

13.3 THE TECHNICAL SITUATION IN THE INDUSTRY

This section presents information on tank truck gasoline loading terminal operations, estimated VOC emissions from terminal operations in Georgia, the extent of current control in use, the requirements of vapor control required by RACT and the likely RACT alternatives which may be used for controlling VOC emissions from affected gasoline terminals in Georgia.

13.3.1 Tank Truck Gasoline Loading Terminal Operations

Tank truck gasoline loading terminals are the primary distribution facilities which receive gasoline from pipelines, tankers and barges; store it in above-ground storage tanks; and subsequently dispense it via tank trucks to bulk gasoline plants and service stations. Tank truck gasoline loading terminals with an average daily gasoline throughput of 20,000 gallons per day or more (as defined by EPA) require vapor control equipment to reduce VOC emissions from gasoline terminal operations in the 12 county non-attainment areas of Georgia. In unclassified areas of Georgia only those facilities with potential emissions over 100 tons annually must comply with the RACT requirements. Terminals which emit 100 tons of VOC emissions or greater were identified by the Georgia Department of Natural Resources, Environmental Protection Division. These facilities are described in detail in Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals, EPA-450/1-77-026.

13.3.2 Emissions and Current Controls

This section presents the estimated VOC emissions from affected tank truck gasoline loading terminals in Georgia in 1977 and the current level of emission control already implemented in the state. Exhibit 13-5, on the following page, shows the total estimated emissions in tons per year from gasoline terminals in Georgia. The estimated VOC emissions from the 33 tank truck gasoline loading terminals are 20,396 tons per year.

The Petroleum Council of Georgia reports that approximately 15 percent of terminals in Georgia currently bottom fill and the remaining 85 percent top submerge fill. This finding is used in this analysis. It is estimated by the Georgia Department of Natural Resources, Department of Environmental Protection that no terminals in Georgia are currently equipped with vapor recovery systems.

Exhibit 13-5
U.S. Environmental Protection Agency
VOC EMISSIONS FROM TANK TRUCK GASOLINE LOADING TERMINALS IN GEORGIA

Number of Facilities	Total Emissions (tons/year)
33	20,396[a]

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[a] Booz, Allen & Hamilton Inc. estimate based on data from the Georgia Department of Natural Resources, Environmental Protection Division.

Source: Booz, Allen & Hamilton Inc. and the Georgia Department of Natural Resources, Environmental Protection Division.

13.3.3 RACT Guidelines

The RACT guidelines for VOC emission control from tank truck gasoline loading terminals require the following control systems:

- Top submerged or bottom fill of gasoline storage tanks and outgoing tank trucks
- Vapor collection from trailer-transport truck loading
- Vapor recovery or thermal oxidation of collected vapors
- Proper operation and maintenance of equipment.

Exhibit 13-6, on the following page, summarizes the RACT guidelines for VOC emissions control from tank truck gasoline loading terminals.

13.3.4 Selection of the Most Likely RACT Alternatives

Control of VOC emissions from tank truck gasoline loading terminals is achieved using submerged or bottom filling of storage tanks and of tank trucks and vapor control of the loading of outgoing trailer-transport trucks. There are several alternative means of achieving vapor control at tank truck gasoline loading terminals, based on the type of vapor control equipment installed.

Four likely alternatives for vapor control are:

- Adsorption/absorption
- Compression refrigeration absorption
- Refrigeration
- Thermal oxidation.

Each type of vapor control system is briefly described below.

13.3.4.1 Adsorption/Absorption (AA)

Vapor control by adsorption/absorption is achieved by the following method. Vapors from tank truck loading operations are collected and directed to one of two activated vapor beds. Vapors are condensed into pores in the carbon.

Exhibit 13-6

U.S. Environmental Protection Agency
VOC EMISSION CONTROL TECHNOLOGY FOR
TANK TRUCK GASOLINE LOADING TERMINALS

Facilities Affected	Sources of Emissions	RACT Control Guideline
Non-Attainment Areas 12 County Area Tank truck terminals with daily throughput of greater than 76,000 liters (20,000 gallons) of gasoline	Filling tank trucks and breathing and working losses from storage tanks	Top submerge or bottom fill tank truck and one of the following vapor control systems: - Adsorption/ Absorption - Refrigeration - Compression Refrigeration Absorption - Thermal Oxidation
Unclassified Areas Only those facilities with potential VOC emission over 100 tons annually.[a]	Leakage	Maintenance of areas that may leak

a. These facilities were identified by the Georgia Department of Natural Resources, Environmental Protection Division

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Source: U.S. Environmental Protection Agency

These vapors are then regenerated by pulling a vacuum over the bed. Cold gasoline is then circulated in a separator and the hot vapors are absorbed into the cold gasoline. This process has recently been marketed and is becoming competitive with the refrigeration system described below. It has been reported that less maintenance is required for this type of vapor recovery system than for the other three types.

13.3.4.2 Compression Refrigeration Absorption (CRA)

Vapor control by compression refrigeration absorption is achieved by the following method. Vapors from tank truck loading operations are collected in a vapor holder. The pressure is increased in the holder, thus causing vapors to condense. Further condensation is then achieved by mixing chilled gasoline and vapors under pressure and the vapors are absorbed into the gasoline. This system is becoming less popular than the more recently developed refrigeration system described below and it is not expected that this type of system will be used in Georgia.

13.3.4.3 Refrigeration (RF)

Vapor recovery using refrigeration is based on the condensation of gasoline vapors by refrigeration at atmospheric pressure. Vapors displaced from tank truck loading operations enter a horizontal fin-tube condenser where they are cooled to a temperature of about -40°F and condensed. Because vapors are treated as they are vented from tank trucks, no vapor holder is required. Condensate is withdrawn from the condenser and the remaining air containing only a small amount of hydrocarbons is vented to the atmosphere. This system is priced competitively with AA systems because of market pressure, although it is estimated to be more costly to build.

13.3.4.4 Thermal Oxidation (OX)

Vapor control by thermal oxidation is achieved by incineration devices. Gasoline vapors are displaced to a vapor holder. When the vapor holder reaches its capacity, vapors are released to the oxidizer, after mixing with a properly metered air stream, and combusted. Later models of this type of thermal oxidizer do not require vapor holders; vapors from the tank trucks during loading operations are vented directly to the thermal oxidizer. It is not expected that this type of vapor control system will be used in Georgia since there are fire hazards with a flame and terminal operators are also reportedly reluctant to burn valuable hydrocarbons.

13.3.5 Leak Prevention from Tank Trucks

For vapor control systems to operate optimally, it is essential to maintain leakless tank trucks. This is achieved by using proper operating procedures and periodic maintenance of hatches, P-V valves and liquid and gaseous connections.

13.4 COST AND HYDROCARBON REDUCTION BENEFIT EVALUATIONS FOR THE MOST LIKELY RACT ALTERNATIVES

Costs for VOC emission control equipment are presented in this section. The costs for the four types of vapor control systems described in Section 13.3 are presented for two model tank truck gasoline loading terminals. The final section presents a projection of model terminal control costs to the statewide industry in Georgia.

13.4.1 Factory Costs for Four Types of Vapor Control Systems

The factory costs for the four types of vapor control systems (summarized in Exhibit 13-7, on the following page) were derived from analysis of the RACT guidelines; from interviews with terminal operators, major oil companies and equipment manufacturers; and from previous cost and economic studies of tank truck gasoline loading terminals.

Adsorption/absorption and refrigeration systems are expected to be the only two types of vapor control systems used at tank truck gasoline loading terminals in Georgia. It is estimated that 50 percent of the systems will be adsorption/absorption and the other 50 percent will be refrigeration systems. Factory costs for both systems are assumed to be equal because of competitive pressures. Maintenance costs for refrigeration systems are approximately 2 percent higher than those for adsorption/absorption systems.

Costs to equip a terminal that currently top submerge fills with a vapor recovery system are identical to costs to equip a terminal that currently bottom fills with a vapor recovery system. This holds true for terminals handling saturated hydrocarbon vapor streams. In cases where Stage 1 for gasoline dispensing are not in effect, a terminal hydrocarbon vapor stream is likely to not be fully saturated. Therefore, it may be possible to equip a bottom fill terminal with a smaller vapor recovery unit than one required to handle a saturated hydrocarbon vapor stream.

13.4.2 Costs for Two Model Tank Truck Gasoline Loading Terminals

Two model tank truck gasoline loading terminals and their associated vapor control costs are characterized in this section. The costs are based on the control estimates

Exhibit 13-7

U.S. Environmental Protection Agency
FACTORY COSTS OF ALTERNATIVE VAPOR CONTROL SYSTEMS

Type of Control System	Factory Cost[a] for 250,000 gallon per day system ($000, 1977)	Factory Cost for 500,000 gallon per day system ($000, 1977)
Adsorption/Absorption	120[b]	155
Compression-Refrigeration-Absorption	128	164
Refrigeration	120[c]	155
Thermal Oxidation	72	95

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[a] Costs are based on average of range of costs quoted by vendors to the U.S. Environmental Protection Agency and reported in The Economic Impact of Vapor Control on the Bulk Storage Industry, draft report, July 1978.

[b] Hydrotech Engineering reported a factory price of $92,000 for a 250,000 gallon per day unit.

[c] Expect system priced competitively to adsorption/absorption system due to market pressure.

Source: Hydrotech, U.S. Environmental Protection Agency, Exxon and Booz, Allen & Hamilton Inc. estimates for adsorption/absorption and refrigeration systems reported by equipment manufacturers and through interviews.

Exhibit 13-8, following Exhibit 13-7, defines two model tank truck gasoline loading terminals characteristics and 50 percent of the terminals in Georgia can be characterized by Model Terminal A; the remaining 50 percent are assumed to be characterized by Model Terminal B.

The costs for the model terminals are used in Section 13.4.3 to project costs of vapor control equipment to the affected industry statewide. The costs for each model terminal are:

- Installed capital cost, which includes equipment and modification costs, labor and costs to modify trucks ($3,000 per truck).
- Annualized direct operating costs which include electricity, maintenance, operating labor and carbon replacement costs. Maintenance costs for the adsorption/absorption system are slightly lower than those for refrigeration.
- Annualized capital charges include costs for depreciation, interest, taxes and insurance and are estimated to be 25 percent of the installed capital cost.
- Net annualized costs, which are the sum of the capital charges and direct operating costs. It should be noted that gasoline credit has not yet been accounted for. Gasoline credit will be taken into account when the costs are projected to the industry.

Another cost characterization that can be made is hydrocarbon reduction versus cost. This finding will also be shown in the statewide analysis.

13.4.3 Projection to the Statewide Industry

Exhibit 13-9, on the following page, shows the projection of vapor recovery costs to the statewide industry in Georgia. The estimates are based on the following assumptions.

Exhibit 13-8
U.S. Environmental Protection Agency
DESCRIPTION AND COST OF MODEL TANK
TRUCK GASOLINE LOADING TERMINALS
EQUIPPED WITH VAPOR CONTROL SYSTEMS

Tank Truck Gasoline Loading Terminal Characteristics	Model Terminal A	Model Terminal B
Throughput	250,000 gallons/day	500,000 gallons/day
Loading racks	1	1
Storage tanks	3	3
Tank trucks	6	15
Compartments per account truck	4	4
Vapor control systems	Adsorption/Absorption Refrigeration	Adsorption/Absorption Refrigeration

Tank Truck Gasoline Loading Terminal Costs	AA	RF	AA	RF
Installed capital cost	$258,000	$258,000	$355,000	$355,000
Annualized direct operating costs				
· Electricity	3,900	9,900	7,800	19,800
· Maintenance	10,800	13,200	13,950	17,050
· Operating labor	1,500	1,500	1,500	1,500
· Carbon replacement	2,400	-	4,700	-
Subtotal (direct operating costs)	18,600	24,600	27,950	38,350
Annualized capital charges	64,500	64,500	88,750	88,750
Net annualized cost (not including gasoline credit)	83,100	89,100	116,700	127,100

Source: Booz, Allen & Hamilton Inc.

Exhibit 13-9

U.S. Environmental Protection Agency

STATEWIDE COSTS OF VAPOR CONTROL SYSTEMS FOR TANK TRUCK GASOLINE LOADING TERMINALS

Characteristic/Cost Item	Data
Number of terminals	33
Total annual throughput (billions of gallons)	6.54
Uncontrolled emissions (tons/year)	20,396
Emission reduction (tons/year)	18,356
Installed capital cost ($ million, 1977)	10.114
Direct annual operating cost ($ millions, 1977)	0.903
Annual capital charges ($ millions, 1977)	2.528
Annual gasoline credit[a] ($ millions, 1977)	3.470
Net annualized cost (credit) ($ millions, 1977)	(.039)
Annual cost (credit) per ton of emissions reduced at the terminal ($ per ton)	(2.12)
Annual cost (credit) per ton of emissions reduced from gasoline marketing ($ per ton)	(1.71)

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a. Based on an estimated 22,783 tons of emissions recovered which includes 3,900 tons collected from gasoline service stations, 527 tons collected from bulk plants and 18,356 tons collected at the terminal. The gasoline is valued at $.39 per gallon.

Source: Booz, Allen & Hamilton Inc.

- In Georgia, 50 percent of the affected tank truck gasoline loading terminals can be characterized by Model Terminal A and the remaining can be characterized by Model Terminal B
- Fifty percent of the affected terminals will implement the adsorption/absorption vapor control system to comply with RACT and the other 50 percent will implement the refrigeration system to comply with RACT
- Terminals outside the 12 county area whose emissions are less than 100 tons are exempted from this analysis
- RACT is implemented at bulk gasoline plants and gasoline service stations in the 12 counties in the state. Ninety percent of the gasoline vapors collected from bulk gasoline plants and 67 percent of the gasoline vapors collected at gasoline service stations are recovered and credited to the tank truck gasoline loading terminal.

Based on the previous assumptions, the total cost to the industry for installing vapor recovery equipment is estimated to exceed $10 million. The amount of gasoline recovered is valued at $3.47 million. The annual credit per ton of emissions controlled from terminals is estimated to be $2.12 per ton. The overall credit per ton of emissions controlled from gasoline marketing in the affected counties in the state is estimated to be $1.71 per ton.

13.5 DIRECT ECONOMIC IMPLICATIONS

This section presents the direct economic implications of implementing RACT controls to the statewide industry, including availability of equipment and capital; feasibility of the control technology; and impact on state economic indicators.

13.5.1 RACT Timing

RACT must be implemented statewide by February, 1982. This requires that tank truck gasoline loading terminal operators must have vapor control equipment installed and operating within the next three years. The timing requirements of RACT impose several requirements on terminal operators including:

- Determining appropriate vapor control system
- Raising capital to purchase equipment
- Acquiring the necessary vapor control equipment
- Installing and testing vapor control equipment to insure that the system complies with RACT.

The sections which follow discuss the feasibility and the economic implications of implementing RACT within the required timeframe.

13.5.2 Feasibility Issues

Technical and economic feasibility issues of implementing RACT controls are discussed in this section.

Several tank truck gasoline loading terminal operators in the United States have successfully implemented vapor control systems. State adoption of RACT regulations will generate a new demand for vapor control systems. It is expected that sufficient leadtime is available to meet the increased demand, thus making the implementation of RACT technically feasible.

RACT must be implemented at terminals in the 12 county area in Georgia. Terminals outside the 12 county area whose emissions are greater than 100 tons must implement RACT controls. Terminals servicing uncontrolled bulk gasoline plants and uncontrolled gasoline dispensing facilities will have problems of equipment compatibility.

In the area of economic feasibility it has been reported that terminal operators have access to capital to purchase vapor control equipment and that no terminals should cease operations because of the cost of implementing RACT. Terminals located in the Savannah area will not have the same amount of vapor recovery credit as will terminals in the 12 county area since bulk gasoline plants and gasoline dispensing facilities are not controlled outside of the 12 county area.

13.5.3 Comparison of Direct Cost With Total Value of Shipments

The net annualized cost to the tank truck gasoline loading terminals resulting from RACT represents an insignificant percent of the total gasoline sold from terminals in the state.

13.6 SELECTED SECONDARY ECONOMIC IMPACTS

This section discusses the secondary economic impact of implementing RACT on employment, market structure and productivity.

- Employment—No decline in employment is predicted since no terminal will close solely because of RACT requirements. A slight increase in operating and maintenance labor will be required through implementation of RACT but this is predicted to have minimal impact on any employment increase.
- Market structure—No change in market structure is expected from implementation of RACT.
- Productivity—No change in worker productivity is expected to result from implementation of RACT.

* * * *

Exhibit 13-10 presents a summary of the findings of this report.

Exhibit 13-10

U.S. Environmental Protection Agency

SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR TANK TRUCK GASOLINE LOADING TERMINALS IN GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	33
Indication of relative importance of industrial section to state economy	1977 industry sales were $2.8 billion, with annual throughput of 6.546 billion gallons.
Current industry technology trends	New terminals will be designed with vapor recovery equipment
1977 VOC actual emissions	20,400 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Submerge fill or bottom fill and vapor recovery

Affected Areas in Meeting RACT	Discussion
Capital investment (statewide)	$10.114 million
Annualized credit (statewide)	$0.039 million (approximately 0.001 percent of value of shipment)
Price	Assuming "full cost pass-through," no change in price
Energy	Assuming full recovery of gasoline—net savings of 125,382 barrels annually from terminal emissions
Productivity	No major impact
Employment	No direct impact
Market structure	No direct impact
Problem area	Full gasoline credit from vapors from bulk gasoline plants and gasoline service stations require uniform RACT requirements throughout the state
VOC emission after control	2,000 tons per year
Cost effectiveness of control	$1.71 annualized credit/annual ton of VOC reduction from terminals assuming gasoline credit from vapors returned from bulk gasoline plants and gasoline service stations

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Source: Booz, Allen & Hamilton Inc.

BIBLIOGRAPHY

Georgia Department of Natural Resources, Environmental Protection Division, Emissions Inventory Data.

National Petroleum News Fact Book, 1976, McGraw Hill, Mid-May 1976.

National Petroleum News Fact Book, 1977, McGraw Hill, Mid-May 1977.

National Petroleum News Fact Book, 1978, McGraw Hill, Mid-June 1978.

Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals, EPA-450/2-77-026, U.S. Environmental Protection Agency, October 1977.

The Economic Impact of Vapor Control on the Bulk Storage Industry, prepared for U.S. Environmental Protection Agency by Arthur D. Little, draft report, July 1978.

Regulatory Guidance for Control of Volatile Organic Compound Emissions from 15 Categories of Stationary Sources, EPA-905/2-78-001, April 1978.

Systems and Costs to Control Hydrocarbon Emissions from Stationary Sources, PB-236 921, Environmental Protection Agency, September 1974.

1972 Census of Wholesale Trade, Petroleum Bulk Stations and Terminals, U.S. Bureau of Census.

Demonstration of Reduced Hydrocarbon Emissions from Gasoline Loading Terminals, PB-234 363.

Private conversation with Mr. Clark Houghton, Mid-Missouri Oil Company.

Private conversation with Mr. Gordon Potter, Exxon, Houston, Texas.

Private conversation with Mr. James McGill, Hydrotech, Tulsa, Oklahoma.

Private conversation with Mr. Frederick Rainey, Shell Oil Company, Houston, Texas.

BIBLIOGRAPHY

National Petroleum News Factbook, 1976, McGraw Hill, Mid-May 1976.

National Petroleum News Factbook, 1977, McGraw Hill, Mid-May 1977.

National Petroleum News Factbook, 1978, McGraw Hill, Mid-June 1978.

Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals, EPA-450/2-77-026, U.S. Environmental Protection Agency.

The Economic Impact of Vapor Control on the Bulk Storage Industry, prepared for U.S. Environmental Protection Agency by Arthur D. Little, draft report, July 1978.

Regulatory Guidance for Control of Volatile Organic Compound Emissions from 15 Categories of Stationary Sources, EPA 905/2-78-001, April 1978.

Systems and Costs to Control Hydrocarbon Emissions from Stationary Sources, PB-236 921, Environmental Protection Agency, September 1974.

1972 Census of Wholesale Trade, Petroleum Bulk Stations and Terminals, U.S. Bureau of Census.

Demonstration of Reduced Hydrocarbons Emissions from Gasoline Loading Terminals, PB-234 363.

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Private conversation with Mr. Gordon Potter, Exxon, Houston, Texas.

Private conversation with Mr. James McGill, Hydrotech, Tulsa, Oklahoma.

Private conversation with Mr. Frederick Rainey, Shell Oil Company, Houston, Texas.

Private conversation with Mr. William Deutsch, Illinois Petroleum Marketers Association, Springfield, Illinois.

14.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT FOR BULK GASOLINE PLANTS IN THE STATE OF GEORGIA

This chapter presents a detailed analysis of the impact of implementing RACT controls for bulk gasoline plants in the State of Georgia. The following 12 counties are considered urban nonattainment counties and are included in the statewide analysis:

- Clayton
- Cobb
- Coweta
- DeKalb
- Douglas
- Fayette
- Fulton
- Gwinnett
- Henry
- Muscogee
- Paulding
- Rockdale.

In areas of the state that are unclassified, only those facilities with potential emissions of over 100 tons annually are subject to control requirements in the regulations. By the EPA definition of a bulk gasoline plant (more than 20,000 gallons throughput per month) it is highly unlikely that any bulk gasoline plants would have potential VOC emissions of over 100 tons per year. Therefore, the RACT guidelines will only apply to bulk gasoline plants in these 12 counties.[1] Throughout the report, therefore, "the State of Georgia" refers to these 12 counties. The chapter is divided into six sections including:

- Specific methodology and quality of estimates
- Industry statistics
- The technical situation of the industry
- Cost and VOC reduction benefit evaluations for the most likely RACT alternatives
- Direct economic implications

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[1] Bulk gasoline plants subject to the regulations in non-attainment areas include all sources emitting 5 pounds in any one hour or 50 pounds in any one day of VOC.

- Selected secondary economic impacts.

Each section presents detailed data and findings based on the RACT guidelines, previous studies of bulk gasoline plants, interviews, and analysis.

14.1 SPECIFIC METHODOLOGY AND QUALITY OF ESTIMATES

This section describes the methodology for determining estimates of:

- Industry statistics
- VOC emissions
- Processes for controlling VOC emissions
- Cost of controlling VOC emissions
- Economic impact of emission control

for bulk gasoline plants in the State of Georgia.

14.1.1 Industry Statistics

Industry statistics on bulk gasoline plants were obtained from several sources. All data were converted to a base year, 1977, based on the following methodologies.

- The number of establishments for 1977 was provided by the Georgia Department of Natural Resources, Environmental Protection Division.

- The number of employees in 1977 was derived from the 1972 Census of Wholesale Trade, Petroleum Bulk Stations and Terminals, by determining the number of employees per establishment in 1972 and multiplying this factor by the number of establishments reported for 1977.

- The number of gallons of gasoline throughput for 1977 in the 12 counties in the State of Georgia was estimated from data supplied by the Georgia Department of Natural Resources, Environmental Protection Division.

- Sales, in dollars, of motor gasoline for 1977 were estimated by multiplying the gasoline throughput in 1977 by the national dealer tankwagon price in 1977 (42.51¢/gallon—reported in the National Petroleum News Fact Book, 1978).

14.1.2 VOC Emissions

VOC emissions from the 12 affected counties in Georgia were estimated using data on bulk plant gasoline throughput and number of tanks supplied by the Georgia Department of

Natural Resources, Environmental Protection Division. Calculations are based on U.S. EPA emission factors provided in Control of Volatile Organic Emissions from Bulk Gasoline Plants, EPA-450/2-77-035.

14.1.3 Processes for Controlling VOC Emissions

Processes for controlling VOC emissions for bulk gasoline plants are described in Control of Volatile Organic Emissions from Bulk Gasoline Plants. These data provide the alternatives available for controlling VOC emissions from bulk gasoline plants. Several studies of VOC emission control were also analyzed in detail, and interviews with petroleum trade associations, bulk plant operators, and vapor control equipment manufacturers were conducted to ascertain the most likely types of control processes which would be used in bulk gasoline plants in Georgia. The specific studies analyzed were: Evaluation of Top Loading Vapor Balance Systems for Small Bulk Plants, EPA 340/1-77-014; Economic Analysis of Vapor Recovery Systems on Small Bulk Plants, EPA 340/1-77-013; Systems and Costs to Control Hydrocarbon Emissions from Stationary Sources, EPA, PB-236 921; and Study of Gasoline Vapor Emission Controls at Small Bulk Plants, EPA PB-267-096.

The alternative types of vapor control equipment likely to be applied to bulk gasoline stations were arrayed, and percentage reductions from using each type of control were determined. The methodology for the cost analysis based on this scheme is described in the following paragraphs.

14.1.4 Cost of Vapor Control Systems

The cost of vapor control systems were developed by:

- Determining the alternative types of control systems likely to be used
- Estimating the probable use of each type of control system
- Defining systems components
- Developing installed capital costs for systems components
- Aggregating installed capital costs for each alternative control system

- Defining two model plants

- Developing costs of control systems for model plants including

  - Installed capital cost
  - Direct operating costs
  - Annual capital charges
  - Gasoline credit
  - Net annualized cost

- Assigning model plant costs to plants in Georgia

- Aggregating costs to the total industry in Georgia.

Costs were determined from analyses of the following previous studies:

- Control of Volatile Organic Emissions from Bulk Gasoline Plants, EPA 450/2-77-035

- Study of Gasoline Vapor Emission Controls at Small Bulk Plants, EPA PB-267-096

- Economic Analysis of Vapor Recovery Systems on Small Bulk Plants, EPA 340/1-77-014

- Evaluation of Top Loading Vapor Balance Systems for Small Bulk Plants, EPA 340/1-77-014

and from interviews with petroleum marketers' associations, bulk plant operators, and vapor control equipment manufacturers.

The estimated cost of control to Georgia was based on information provided by the Georgia Department of Natural Resources, Environmental Protection Division. Plant characteristics determined from this data included:

- Plant throughput
- Number of storage tanks per facility.

It was assumed that top splash loading was employed at 50 percent of the plants and top submerged loading at the remaining plants.

14.1.5 Economic Impacts

The economic impacts were determined by analyzing the lead time requirements needed to implement RACT; assessing the feasibility of instituting RACT controls in terms of capital availability and equipment availability; comparing the direct costs of RACT control to various state economic indicators; and assessing the secondary effects on market structure, employment, and productivity as a result of implementing RACT controls for the 12 counties in Georgia.

14.1.6 Quality of Estimates

Several sources of information were utilized in assessing the emissions, cost, and economic impact of implementing RACT controls on bulk gasoline plants in Georgia. A rating scheme is presented in this section indicating quality of the data available for use in this study. A rating of "A" indicates hard data (i.e., data that are published for the base year); "B" indicates data that were extrapolated from hard data; and "C" indicates data that were not available in secondary literature and were estimated based on interviews, analyses of previous studies, and best engineering judgment. Exhibit 14-1, on the following page, rates each study output listed and the overall quality of the data.

Exhibit 14-1

U.S. Environmental Protection Agency
DATA QUALITY

Study Outputs	A Hard Data	B Extrapolated Data	C Estimated Data
Industry statistics	●		
Emissions		●	
Cost of emissions control		●	
Statewide costs of emissions			●
Economic impact		●	
Overall quality of data		●	

Source: Booz, Allen & Hamilton, Inc.

14.2 INDUSTRY STATISTICS

Industry characteristics, statistics, and business trends for bulk gasoline plants in Georgia are presented in this section. The discussion includes a description of the number of facilities and their characteristics, a comparison of the size of the bulk gasoline plant industry to state economic indicators, a historical characterization and description of the industry, and an assessment of future industry patterns. Data in this section form the basis for assessing the impact on this industry of implementing RACT guidelines to VOC emissions from bulk gasoline plants in Georgia.

14.2.1 Size of the Industry

There were an estimated 35 bulk gasoline plants, as of 1977, in the 12 counties in Georgia. Industry sales were in the range of $27 million, with an estimated yearly throughput of 64.11 million gallons of gasoline. The estimated number of employees in 1977 was 209. These data and the sources of information are summarized in Exhibit 14-2, on the following page. Annual capital investments have not been estimated. In general, bulk plant capital investments are for plant and equipment to replace worn-out facilities, modernize the establishments, or improve operating efficiencies.

14.2.2 Comparison of the Industry to the State Economy

A comparison of the bulk gasoline plant industry in the 12 counties to the economy of the State of Georgia is shown in this section by comparing industry statistics to state economic indicators. Employees in the affected bulk gasoline plant industry represent less than 0.01 percent of the total state civilian labor force of Georgia. The value of gasoline sold from the 35 bulk plants represented less than one percent of the total value of wholesale trade in Georgia in 1977.

14.2.3 Characterization of the Industry

Bulk plants are an intermediate distribution point in the petroleum product marketing network as shown in Exhibit 14-3, following Exhibit 14-2. Bulk gasoline plants compete with bulk gasoline tank terminals and large retail

Exhibit 14-2

U.S. Environmental Protection Agency

INDUSTRY STATISTICS FOR BULK GASOLINE PLANTS IN GEORGIA

Number of Establishments	Number of Employees	Sales ($ Million, 1977)	Gasoline Sold (Millions of Gallons)
35[a]	209[b]	27[c]	46[a]

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a. Data provided by Georgia Department of Natural Resources, Environmental Protection Division.

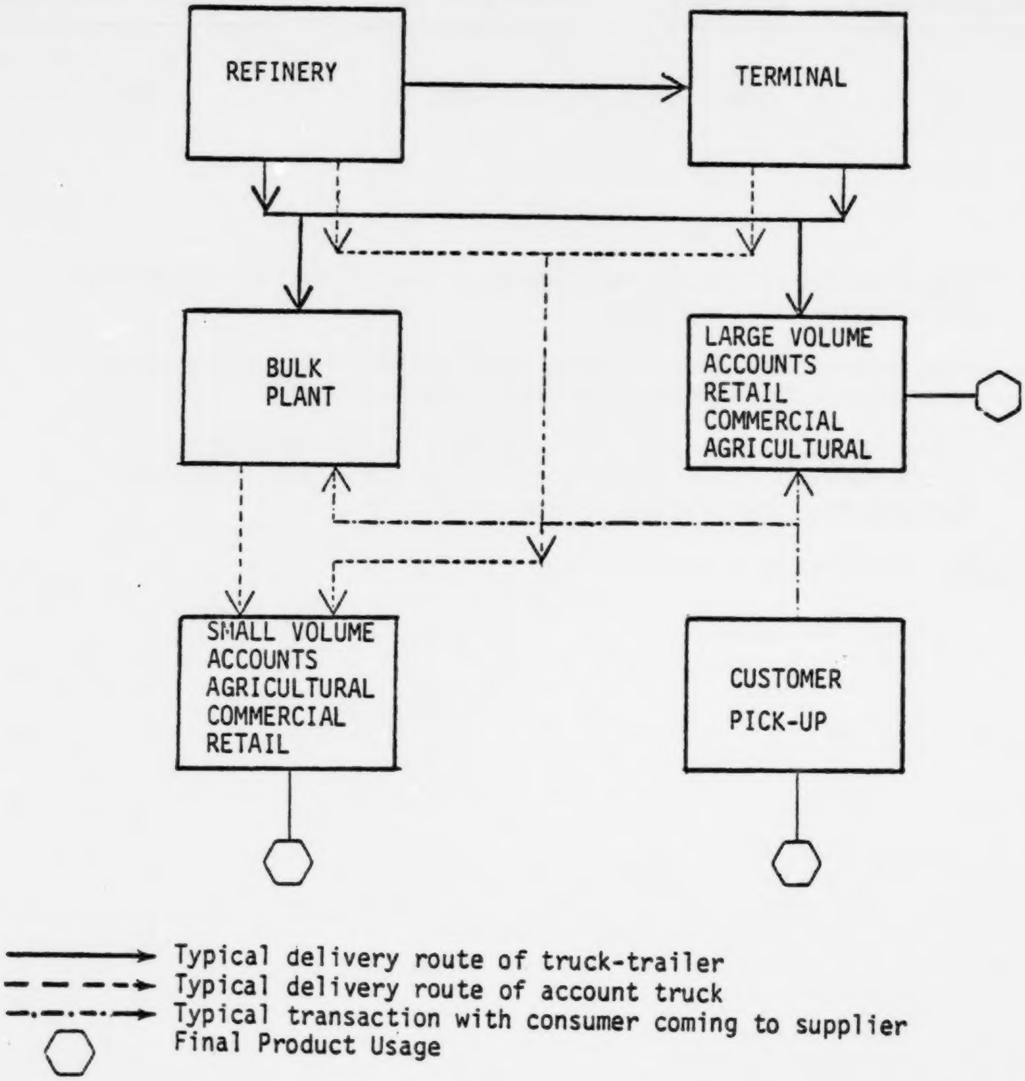
b. Booz, Allen & Hamilton estimate based on the ratio of the number of employees to the number of establishments in 1972.

c. Number of gallons of gasoline throughput in 1977 multiplied by the national dealer tankwagon price in 1977 (42.51¢/gallon), National Petroleum News Fact Book, 1978.

Source: Booz, Allen & Hamilton Inc.

Exhibit 14-3

U.S. Environmental Protection Agency
GASOLINE DISTRIBUTION NETWORK


REFINERY
TERMINAL
BULK PLANT
LARGE VOLUME ACCOUNTS RETAIL COMMERCIAL AGRICULTURAL
SMALL VOLUME ACCOUNTS AGRICULTURAL COMMERCIAL RETAIL
CUSTOMER PICK-UP
Typical delivery route of truck-trailer
Typical delivery route of account truck
Typical transaction with consumer coming to supplier
Final Product Usage

Source: "Economic Analysis of Vapor Recovery Systems on Small Bulk Plants," EPA 340/1-77-013, September 1976, p. 3-2.

gasoline outlets. Ownership and operation of bulk plants are predominantly by independent jobbers and commissioned agents but also include cooperatives and salaried employees. The independent jobber owns the equipment and structures at his bulk plant, the inventory, and rolling stock, and he contracts directly with the oil company for gasoline. A commissioned agent usually does not own the equipment and facilities but operates the bulk plant for a major integrated oil company.

The maximum daily throughput of a bulk gasoline plant ranges from less than 2,000 gallons per day up to 20,000 gallons per day. Exhibit 14-4, on the following page, shows the distribution of bulk gasoline plants by plant throughput in the 12 counties in Georgia.

It is estimated that the majority of the bulk gasoline plants are up to 25 years old, with a few new modernized, higher volume plants. Forty years ago, bulk gasoline plants were a major link in the gasoline distribution network. From that time, their importance has been declining in the marketing sector of the petroleum industry, basically for economic reasons. There is evidence that profitability in bulk gasoline plants has been decreasing. The number of bulk gasoline plants decreased by 11 percent nationally from 1967 to 1972 and is predicted to continue declining in the near term.[1] This decline is largely attributable to major oil companies disposing of commission-agent-operated bulk plants.

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[1] National Petroleum News Fact Book, 1976.

Exhibit 14-4

U.S. Environmental Protection Agency
DISTRIBUTION OF BULK GASOLINE PLANTS BY AMOUNT OF THROUGHPUT

Gasoline Throughput (gallons per day)	Percentage of Plants
Less than 2,000	14
2,000 to 3,999	11
4,000 to 5,999	17
6,000 to 7,999	40
8,000 to 9,999	6
10,000 to 11,999	3
12,000 to 13,999	3
14,000 to 15,999	6
16,000 to 17,999	0
18,000 to 20,000	0

Source: Georgia Department of Natural Resources.

14.3 THE TECHNICAL SITUATION IN THE INDUSTRY

This section presents information on bulk gasoline plant operation, estimated VOC emissions from bulk gasoline plant operations in the 12 counties in Georgia, the extent of current control in use, the requirements of vapor control required by RACT and the likely RACT alternatives which may be used for controlling VOC emissions from bulk gasoline plants in Georgia.

14.3.1 Bulk Gasoline Plant Operations

Bulk gasoline plants are typically secondary distribution facilities which receive gasoline from bulk gasoline tank terminals by trailer-transport trucks; store it in above-ground storage tanks; and subsequently dispense it via account trucks to local farms, businesses and service stations. Bulk gasoline plant operations are discussed in detail in Control of Volatile Organic Emissions from Bulk Gasoline Plants, EPA 450/2-77-035.

14.3.2 Emissions and Current Controls

This section presents the estimated VOC emissions from bulk gasoline plants in the 12 counties in Georgia in 1977. Exhibit 4-5, on the following page, shows the total estimated emissions in tons per year from bulk plants in Georgia. The estimated VOC emissions from the 35 bulk plants are 733 tons per year.

It was assumed that 50 percent of loading facilities in the 12 affected Georgia counties are currently equipped with submerged loading equipment and that 50 percent are equipped with top-load splash-fill loading equipment based on data provided by the Georgia Department of Natural Resources, Environmental Protection Division.

14.3.3 RACT Guidelines

The RACT guidelines for VOC emission control from bulk gasoline plants require the following control systems:

- Top submerged or bottom fill of gasoline storage tanks and outgoing account trucks
- Vapor balancing between the incoming trailer-transport truck and the gasoline storage tank

Exhibit 14-5

U.S. Environmental Protection Agency

VOC EMISSIONS FROM BULK GASOLINE PLANTS IN GEORGIA

Number of Facilities	Estimated Number of Tanks	Average Daily Throughput	Total Emissions (tons/year)
35	107	256,437	733

Source: Georgia Department of Natural Resources, Environmental Protection Division.

- Vapor balancing between the gasoline storage tank and the outgoing account truck

- Proper operation and maintenance of equipment.

Exhibit 14-6, on the following page, summarizes the RACT guidelines for VOC emissions control from bulk gasoline plants.

14.3.4 Selection of the Most Likely RACT Alternatives

Control of VOC emission from bulk gasoline plants is achieved using submerged or bottom filling of storage tanks and account trucks; and vapor balancing between the loading and unloading of incoming and outgoing trailer-transport trucks and the gasoline storage tanks. There are several alternative means of achieving vapor control at bulk gasoline plants, based on the manner in which the bulk plant is operated.

Three likely control alternatives, summarized in Exhibit 14-7, following Exhibit 14-6, are discussed separately in the paragraphs which follow.

14.3.4.1 Alternative I

Control Alternative I involves converting existing top loading bulk plants to top submerged loading and equipping the bulk plant with a vapor balancing system. In detail, this control alternative implies:

- Submerged filling of gasoline storage tanks

- Vapor balancing between the incoming trailer-transport truck and the gasoline storage tank

- Submerged top loading of outgoing account trucks

- Vapor balancing of gasoline storage tank and outgoing account truck

- Equipping account trucks with vapor balancing connections.

It is estimated that most of the bulk plants in Georgia would select Control Alternative I to achieve vapor recovery to meet the state RACT requirements. During interviews, the

EXHIBIT 14-6
U.S. Environmental Protection Agency
VOC EMISSION CONTROL TECHNOLOGY FOR
BULK GASOLINE PLANTS

Facilities Affected	Sources of Emissions	RACT Control Guideline
Bulk plants with daily throughputs of 76,000 liters (20,000 gallons) of gasoline or less	Vapor displacement from filling account trucks, and breathing losses and working losses from storage tanks	Submerge filling and vapor balancing: . Vapor balancing of transport truck and storage tank . Vapor balancing of storage and account truck
	Cracks in seals and connections	Proper operation maintenance
	Improper hook up of liquid lines and top loading nozzles	Proper operation maintenance
	Truck cleaning	Proper operation maintenance
	Pressure vacuum relief valves	Proper operation maintenance

Source: Control of Volatile Organic Emissions from Bulk Gasoline Plants, EPA-450/2-77-035.

Exhibit 14-7

U.S. Environmental Protection Agency

ALTERNATIVE CONTROL METHODS

FOR VAPOR CONTROL AT BULK GASOLINE PLANTS

Alternative Number	Description of Control Method
I	Convert existing top filled plant to top submerged filling and vapor balance entire system
II	Vapor balance existing bottom filled bulk plant
III	Convert top filled bulk plant to bottom filled, and vapor balance total system

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Source: Booz, Allen & Hamilton analysis of Control of Volatile Organic Emissions from Bulk Gasoline Plants industry has questioned whether vapor recovery by this control method will achieve 90 percent emissions recovery as stated in the RACT guidelines.

14.3.4.2 Alternative II

Control Alternative II involves implementing a complete vapor balancing system on bulk plants which currently operate with bottom filling. In detail this control alternative encompasses:

- Vapor balancing between the incoming trailer-transport truck and the gasoline storage tank
- Vapor balancing between the gasoline storage tank and the outgoing account truck
- Modification of account trucks to accommodate a vapor recovery connection.

14.3.4.3 Alternative III

Control Alternative III involves converting top loading bulk gasoline plants to bottom filling and implementing a complete vapor balancing system. In detail, this control alternative entails:

- Converting the loading rack to bottom filling
- Converting storage tank loading to bottom filling
- Vapor balancing the incoming trailer-transport truck and the gasoline storage tank
- Converting the account truck to bottom loading and installing vapor balancing connections on the account truck.

The additional cost of converting a bulk plant from top filling to bottom filling makes Control Alternative III more costly than Control Alternative I. This additional cost may be attributable to improved bulk plant operations, according to U.S. EPA.

14.4 COST AND HYDROCARBON REDUCTION BENEFIT EVALUATIONS FOR THE MOST LIKELY RACT ALTERNATIVES

Costs for VOC emission control equipment are presented in this section. The costs for the three alternative control systems described in Section 14.3 are described individually, followed by costs for typical bulk plants. The final section then presents a projection of typical bulk gasoline plant control costs to the industry in the 12 counties in Georgia.

14.4.1 Costs for Alternative Control Systems

The costs for the three alternative control systems (summarized in Exhibit 14-8, on the following page) were derived from analysis of the RACT guidelines, from interviews with bulk plant operators and petroleum marketing trade associations and from previous cost and economic studies of small bulk plants.

Control Alternative I is expected to be the most widely applied system for bulk plants in Georgia since it is assumed that most bulk gasoline plants in Georgia employ top loading. The U.S. EPA currently endorses the cost estimates developed by Pacific Environmental Services, Inc. for the Houston/Galveston area bulk plants. However, several large volume bulk plant operators who were interviewed have reported vapor control costs in excess of $50,000 which included conversion of the loading rack to bottom filling.

Control Alternative II is similar in cost to Control Alternative I. Bulk plants which may currently bottom fill must equip their plants with vapor balancing to comply with RACT.

Control Alternative III is the most costly control system. Several bulk gasoline plant operators interviewed in California and Maryland have adopted this system, although it cannot be shown from the data in Georgia that any bulk gasoline plant operator in Georgia would be willing to implement a system this costly. This alternative, therefore, is not included in the determination of vapor control costs to the statewide industry in the next section.

Exhibit 14-8
U.S. Environmental Protection Agency
COSTS OF ALTERNATIVE VAPOR CONTROL SYSTEMS

Cost Estimate	Alternative I	Alternative II	Alternative III (Includes conversion to bottom filling)
National Oil Jobbers Council estimate	1 truck (4-compartments) 1 loading rack (3 arms) 3-inch system Pre-set meters Direct Cost (no labor) $20,524 (without air) $22,754 (with air)	Similar to costs for alternative I	1 truck (4-compartments) 1 loading rack (3 arms) 3-inch system Pre-set meters Direct cost (No labor) $27,729
Pacific Environmental Services estimate of Houston/Galveston area system	1 loading rack Meters Average installed cost $3,200 (without metering) $7,700 (with metering)		
Wiggins system			1 truck 4-compartments) 1 loading rack (4 arms) Pre-set meters Installed cost $17,352-$18,416

Source: National Oil Jobbers Council, Pacific Environmental Services Inc., Wiggins Division, Delaware Turbines, Inc.

14.4.2 Costs for Two Model Bulk Plants

Two model bulk plants and their associated vapor control costs are characterized in this section. The costs are based on the control estimates for Control Alternative I, reported by Pacific Environmental Services, Inc. for bulk plants in the Houston/Galveston area. Several other bulk plant operators have reported costs in excess of $50,000 for vapor control systems although these cost estimates exceed the level of control required to meet the RACT requirements.

Exhibit 14-9, on the following page, defines two model bulk plant characteristics and associated control costs. It is assumed that approximately 90 percent of the bulk plants in Georgia can be characterized by Model Plant A; the remaining 10 percent are assumed to be characterized by Model Plant B.

The costs for the model plants are used in section 14.4.3 to determine costs of vapor control equipment to the industry in 12 affected counties in Georgia. The costs for each model plant are:

- Installed capital cost, which includes parts and labor
- Annualized direct operating costs, expected to be 3 percent of installed capital costs, including costs for labor, utilities, recordkeeping, and training costs
- Annualized capital charges, estimated to be 25 percent of installed capital costs, including costs for depreciation, interest, maintenance, taxes, and insurance
- Net annualized operating costs, which are the sum of the capital charges and direct operating costs. It should be noted that gasoline credit has not yet been accounted for. Gasoline credit will be taken into account when the costs are determined for the industry.

Another cost characterization that can be made is hydrocarbon reduction versus cost. This finding will also be shown in the statewide analysis.

Exhibit 14-9

U.S. Environmental Protection Agency
DESCRIPTION AND COST OF MODEL BULK PLANTS EQUIPPED WITH VAPOR CONTROL SYSTEMS

Bulk Plant Characteristics	Model Bulk Plant A	Model Bulk Plant B
Throughput	2,500 gallons/day	13,000 gallons/day
Loading racks	1	1
Storage tanks	3	3
Account trucks	2	4
Compartment per account truck	4	4
Vapor control system	Alternative I	Alternative I
Bulk Plant Costs		
Installed capital cost[a]	$13,700	$19,700
Annualized direct operating costs @ 3 percent of installed cost	411	591
Annualized capital charges @ 25 percent of installed capital cost	3,425	4,925
Net annualized cost (not including gasoline credit)	3,836	5,516

a. Cost to modify one 4-compartment account truck estimated to be $3,000.

Source: Booz, Allen & Hamilton, Inc.

14.4.3 Costs to the 12 Countywide Industry

Exhibit 14-10, on the following page, shows the vapor recovery costs to the 12 countywide industry in Georgia. The estimates are based on the following assumptions:

- Ninety percent of the bulk gasoline plants in these counties can be characterized by Model Plant A and the remaining can be characterized by Model Plant B
- All bulk plants will implement the Control Alternative I vapor control system to comply with RACT.

Actual costs to bulk plant operators may vary depending on the type of control alternative and manufacturer's equipment selected by each bulk plant operator.

Based on the above assumptions, the total cost to the industry affected for installing vapor recovery equipment is estimated to exceed $500,000. The amount of gasoline prevented from vaporizing using vapor control is valued at approximately $9,200. Approximately ten percent of total emissions can be credited to the bulk plant since installation of vapor control equipment will reduce the amount of vaporization by approximately 10 percent. The annual cost per ton of emissions controlled is estimated to be $225 per ton.

The statewide costs of vapor control systems by size of bulk gasoline plant are analyzed and arrayed in Exhibit 14-11. It is noted that bulk plants with throughput less than 4,000 gallons per day achieve only 10 percent reduction in overall emissions yet bear over 25 percent of the annual cost of hydrocarbon emission control.

Exhibit 14-10

U.S. Environmental Protection Agency

GEORGIA COSTS OF VAPOR CONTROL SYSTEMS FOR BULK GASOLINE PLANTS IN THE 12 COUNTY AREA

Characteristics/Cost Item	DATA
Number of facilities	35
Total annual throughput (millions of gallons)	64
Uncontrolled emissions (tons/year)	733
Emission reduction (tons/year)	586
Net emissions (tons/year)	147
Installed capital ($, 1977)	503,000
Direct annual operating cost ($, 1977)	15,000
Annualized capital charges ($, 1977)	126,000
Annual gasoline credit[a] ($, 1977)	9,200
Net annualized cost ($, 1977)	132,000
Annualized cost per ton of emissions reduced	225

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a. Based on 10 percent of emission reduction accrued to bulk plants at 40¢ per gallon

Source: Booz, Allen & Hamilton, Inc.

Exhibit 14-11
U.S. Environmental Protection Agency
STATEWIDE COSTS OF VAPOR CONTROL SYSTEM BY SIZE OF BULK GASOLINE PLANT

Bulk Plant Gasoline Throughput (gallons per day)	Percentage of Plants	Current Estimated Annual VOC Emissions (tons per year)	Estimated Annual VOC Emissions After RACT Control (tons per year)	Net VOC Emission Reduction (tons per year)	Percentage of Total VOC Emissions Reduced	Estimated Annual Cost ($ millions, 1977)	Percent of Total Annual Cost	Net Hydrocarbon Cost Effectiveness ($, 1977 / tons per year)
Less than 2,000	14	24	5	19	3.2	18,055	14	950
2,000 - 3,999	11	48	10	38	6.5	14,444	11	380
4,000 - 5,999	17	104	21	83	14.2	21,666	16	261
6,000 - 7,999	40	326	65	261	44.5	50,554	38	194
8,000 - 9,999	6	56	11	45	7.7	7,223	5	161
10,000 - 11,999	3	37	7	30	5.1	4,970	4	166
12,000 - 13,999	3	40	8	32	5.5	4,971	4	155
14,000 - 15,999	6	98	20	78	13.3	9,941	8	127

Source: Booz, Allen & Hamilton, Inc.

14.5 DIRECT ECONOMIC IMPLICATIONS

This section presents the direct economic implications of implementing RACT controls to the industry, in the 12 counties in Georgia, including availability of equipment and capital; feasibility of the control technology; and impact on economic indicators, such as value of shipments, unit price (assuming full cost passthrough), state economic variables and capital investment.

14.5.1 RACT Timing

The Georgia deadline for implementing RACT guideline control requirements is July 1, 1982. This requires that bulk gasoline plant operators must have vapor control equipment installed and operating within the next three years. The timing requirements of RACT impose several requirements on bulk plant operators including:

- Determining appropriate vapor control system
- Raising capital to purchase equipment
- Generating sufficient income from current operations to pay the additional annual operating costs incurred with vapor control
- Acquiring the necessary vapor control equipment
- Installing and testing vapor control equipment to insure that the system complies with RACT.

The sections which follow discuss the feasibility and the economic implications of implementing RACT within the required timeframe.

14.5.2 Feasibility Issues

Technical and economic feasibility issues of implementing RACT controls are discussed in this section.

Several bulk plants in the U.S. have attempted to implement vapor control systems with varying degrees of success. One bulk plant operator interviewed in Maryland implemented vapor recovery at a cost of $65,000 in 1974. The operator indicated that recent tests have shown the system operates well within the 90 percent recovery requirement of RACT. This particular bulk plant was converted to bottom filling and completely vapor balanced. The plant's throughput was 20,000 gallons per day and included one loading rack and three account trucks. This plant would be characterized as installing a sophisticated Alternative III control system. The plant is also operated by a major oil company, so capital availability problems were not similar to a small, independently owned bulk plant.

Bulk plants in the Houston/Galveston area, on the contrary, have implemented "bare bone" type control systems that were individually designed and installed at a bulk plant which was owned by a major oil company. No emission data are available to verify whether these systems are in compliance, but U.S. EPA estimates that these control systems are sufficient to meet the requirements of RACT. These systems are not marketed by any equipment manufacturer; therefore, their availability for widespread application is doubtful at the present time.

State adoption of RACT regulations will generate a demand for economical vapor control systems for bulk gasoline plants. There may be a shortage of off-the-shelf systems in the next three years since the Houston/Galveston type systems have not yet been fully demonstrated.

A number of economic factors are involved in determining whether a specific bulk plant operator will be able to implement vapor control systems and still remain profitable. These include:

- Degree of competition
- Ability to pass on a price increase
- The current profitability of the plant
- Age of the plant
- State of repair of the plant
- Ownership—major oil company or private individual.

It is estimated that small bulk plants, with throughput less than 3,500 gallons per day, will experience a direct cost increase of nearly 0.5 cents per gallon if they implement RACT. This will affect an estimated 15 percent of the bulk plants in the state.

The key to the direct economic impact will be the ability of a bulk plant operator to pass on up to a 0.5 cent increase in the price of gasoline to customers (assuming a full cost passthrough). One small bulk plant operator in Missouri reported during an interview that his profit margin per gallon of gasoline is 4 to 5 cents per gallon. His net profit margin is 0.5 cent per gallon. This operator stated that he plans to discontinue operations rather than comply with RACT. Again, sufficient data are not available to determine if this would be typical of small bulk plants in the state. In a previous study of the economics of vapor recovery for small bulk plants, a trend of declining profitability in bulk plant operations was identified.[1] If this trend continues, vapor control systems may not be affordable at marginal plants. Many bulk plants now operate at a profit only because their plants are fully depreciated. In the same study it was also determined that a large percentage of small bulk plants may not be able to raise sufficient capital to purchase vapor control equipment. Furthermore, it is estimated that the price of vapor control systems is likely to increase in the future at a rate greater than the GNP. One bulk plant operator stated that prices for vapor control have risen 30 percent over the past three years. It is therefore predicted that the industry decline will continue and that some bulk plant operators will cease operations because of their present financial condition and the additional financial burden of the RACT requirements.[2]

The paragraphs which follow compare statewide compliance costs of RACT control, in 1977 dollars, to various economic indicators.

14.5.3 Comparison of Direct Cost With Selected Direct Economic Indicators

This section presents a comparison of the net increases in the annual operating cost of implementing RACT with the total value of gasoline sold in the state, and the unit price of gasoline.

The net increase in the annual operating cost to the bulk gasoline plants due to RACT represents 0.48 percent of the total gasoline sold from bulk plants in the affected 12 counties in the state. The impact on the unit price of gasoline varies with the bulk plant throughput. As discussed in the preceding section, the small bulk plants

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1. Economic Analysis of Vapor Recovery Systems on Small Bulk Plants, EPA 340/1-77-013, September 1976.

2. Interview with Mr. Harrison Bray, Georgia Oilmen's Association, Atlanta, Georgia.

may experience a direct cost increase of up to 0.5 cent per gallon of gasoline sold, whereas the large bulk plants may experience a much smaller direct cost increase.

14.6 SELECTED SECONDARY ECONOMIC IMPACTS

This section discusses the secondary impact of implementing RACT on employment, market structure, and productivity.

For bulk gasoline plants that comply with the RACT requirements, no additional manpower requirements are expected. Overall bulk gasoline plant industrial sector employment is expected to continue to decline since the number of bulk gasoline plants operating in the state is forecast to decline. Based on the statewide estimates of number of employees and number of bulk plants, an average of approximately 6 jobs will be lost with the closing of a bulk plant. No estimate was made of the number of bulk plants that may close due to RACT.

The impact on the market structure for bulk plants differs significantly in urban and rural areas. The importance of bulk plants in the urban areas is declining because of competition from retailers and tank truck terminals and will continue to decline regardless of RACT requirements.

In rural areas, the bulk plants serve as a vital link in the gasoline distribution network, since large trailer transport trucks cannot be accommodated by many rural roads serving the farm accounts. It is estimated that approximately 60 percent of the customers served by the small bulk plants in the rural areas are farm accounts, which could be severely impacted if the small bulk plants are forced out of business. However, in Georgia the bulk gasoline plants that would be required to meet the RACT requirements are in the 12 county non-attainment area (primarily metropolitan Atlanta). The increased operating cost of complying with RACT may create market imbalance if the compliance cost cannot be passed on to the market place in terms of a price increase (i.e., the market structure could tend to concentrate further). Bulk plants not equipped with vapor control equipment may not be able to serve gasoline service stations equipped with vapor control equipment due to incompatible hardware configurations. A uniform policy, therefore, is necessary so that market disruptions due to equipment incompatibility are minimized. In Georgia service stations in the 12 county non-attainment area also will require vapor balance systems. In addition to the bulk gasoline plants identified in this chapter, there are likely to be some additional plants outside this area serving service stations with control systems.

However, some vapor control systems may decrease plant productivity if flow rates substantially decline, requiring longer times to load and unload trucks.

* * * *

Exhibit 14-12, on the following page, presents a summary of the findings of this report.

Exhibit 14-12

U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR BULK GASOLINE PLANTS IN GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	35
Indication of relative importance of industrial sector to state economy	1977 affected industry sales were $27 million, with annual throughput of 0.064 billion gallons.
Current industry technology tends	Only small percent of industry has new/modernized plants
1977 VOC actual emissions	730 tons per year
Industry preferred method of VOC control to meet RACT guidelines	Bottom fill and vapor balancing (cost analysis reflects top submerged fill, not bottom fill)

Affected Areas in Meeting RACT	Discussion
Capital investment (statewide)	$500,000
Annualized cost (statewide)	$130,000 (approximately 0.45 percent of value of shipments from those facilities affected
Price	Assuming a "direct cost pass-through" · 12 county-wide--$0.0048 per gallon increase · Small operations--$0.005 to $0.01 per gallon increase
Energy	Assuming full recovery of gasoline—net savings of 4,000 barrels annually
Productivity	No major impact
Employment	No direct impact; however for plants closing, potential average of 6 jobs lost per plant closed
Market structure	Regulation could further concentrate a declining industry. Many small bulk gas plants today are marginal operations; further cost increase could result in some plant closings
Problem area	Severe economic impact for small bulk plant operations. Regulation could cause further market imbalances. Technical control feasibility of cost effective alternatives has not been effectively demonstrated
VOC emission after control	150 tons per year
Cost effectiveness	$225 annualized cost/annual ton of VOC reduction

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Source: Booz, Allen & Hamilton Inc.

BIBLIOGRAPHY

Georgia Department of Natural Resources, Environmental Protection Division, Emissions Inventory.

National Petroleum News Fact Book, 1967, McGraw Hill, Mid-May 1976.

National Petroleum News Fact Book, 1977, McGraw Hill, Mid-May 1977.

National Petroleum News Fact Book, 1978, McGraw Hill, Mid-June 1978.

Economic Analysis of Vapor Recovery Systems on Small Bulk Plants, EPA 340/1-77-013, September 1976.

Stage I Vapor Recovery and Small Bulk Plants in Washington, D.C., Baltimore, Maryland, and Houston/Galveston, Texas, EPA 340/1-77-010, April 1977.

Evaluation of Top Loading Vapor Balance Systems for Small Bulk Plants, EPA 340/1-77-014, April 1977.

Regulatory Guidance for Control of Volatile Organic Compound Emissions from 15 Categories of Stationary Sources, EPA 905/2-78-001, April 1978.

Systems and Costs to Control Hydrocarbon Emissions from Stationary Sources, PB-236 921, Environmental Protection Agency, September 1974.

Control of Volatile Organic Emissions from Bulk Gasoline Plants, EPA 450/2-77-035, December 1977.

Memorandum, "Meeting with EPA and Others on Bulk Plant Vapor Recovery," National Oil Jobbers Council, Mr. Bob Bassman, Counsel, March 21, 1978.

Letter to Mr. William F. Hamilton, Economic Analysis Branch, United States Environmental Protection Agency, from California Independent Oil Marketers Association, February 28, 1978.

Private conversation with Mr. Clark Houghton, Missouri Bulk Plant Operator.

Private conversation with Mr. D. L. Adams, Phillips Petroleum, Towson, Maryland.

Private conversation with Mr. Robert Schuster, bulk plant operator in Escondido, California.

Private conversation with Mr. Burton McCormick, bulk plant operator in Santa Barbara, California.

"The Lundburg Letter," Pele-Drop, North Hollywood, California.

"1978 Marketing Directory and Yearbook," Michigan Petroleum Association, 1978

Private conversation with Mr. William Deutsch, Illinois Petroleum Marketers Association, Springfield, Illinois.

Bray, Georgia Oilmen's Assoication, Atlanta Georgia.

15.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT FOR STORAGE OF PETROLEUM LIQUIDS IN FIXED-ROOF TANKS IN THE STATE OF GEORGIA

This chapter presents a detailed analysis of the impact of implementing RACT controls for the storage of petroleum liquids in fixed-roof tanks. The RACT guidelines will apply to all fixed-roof storage tanks with greater than 40,000 gallons capacity in the following 12 counties which are part of urban non-attainment areas:

- Clayton
- Cobb
- Coweta
- DeKalb
- Douglas
- Fayette
- Fulton
- Gwinnett
- Henry
- Muscogee
- Paulding
- Rockdale

and to facilities in the remainder of the state that have potential VOC emissions over 100 tons annually. The major sections of the chapter include:

- Specific methodology and quality of estimates
- Technical characteristics of fixed-roof tanks for storing petroleum liquids
- Profile of statewide fixed-roof tank industry and estimated annual VOC emissions
- Cost of controlling VOC emissions
- Economic impact.

Each section presents detailed data and findings based on analyses of the RACT guidelines, previous studies of fixed-roof storage tanks, interviews with industry representatives and analysis.

15.1 SPECIFIC METHODOLOGY AND QUALITY OF ESTIMATES

This section describes the methodology for determining:

- Technical characteristics of fixed-roof tanks
- Profile of fixed-roof tanks
- VOC emissions
- Cost of vapor control systems
- Economic impact of emission control for the storage of petroleum liquids in fixed-roof tanks.

The quality of these estimates is discussed in the last part of this section.

15.1.1 Technical Characteristics of Fixed-Roof Tanks

The technical characteristics of fixed-roof tanks and processes for controlling their emissions were obtained mainly from the RACT guideline entitled Control of Volatile Organic Emissions from Storage of Petroleum Liquids in Fixed-Roof Tanks. EPA-4501/2-77-036, and from several other studies of fixed-roof tanks listed in the reference section of this report.

15.1.2 Profile of Fixed-Roof Tanks

The Georgia Department of Natural Resources provided a listing of all fixed-roof tanks greater than 40,000-gallon capacity used for storing petroleum liquids in the 12-county urban non-attainment areas and a listing of all fixed-roof tanks with the potential for greater than 100 tons per year VOC emissions in the remainder of the state. The capacity of each tank, the type of petroleum liquid stored, and for some facilities, the annual throughput, were provided. Where not available, the annual throughput was calculated based on an assumed turnover rate of 25 cycles per year.[1]

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[1] Based on throughput data for fixed-roof tanks in the State of Kentucky, supplied by Kentucky Department of Natural Resources and Environmental Protection.

15.1.3 VOC Emissions

Statewide VOC emissions were provided for petroleum liquids stored in fixed-roof tanks in Georgia by the Georgia Department of Natural Resources, or calculated based on the emission factors for working and breathing losses of various types of petroleum liquids. The emission factors were obtained from Revision of Evaporative Hydrocarbon Emission Factors, EPA-450/3-76-039.

15.1.4 Cost of Vapor Control Systems

The costs of vapor control systems were developed by:

- Determining the type of control system
- Developing installed capital costs for each tank
- Developing total annual costs of control systems for the number of tanks in the state including:
    - Installed capital cost
    - Direct operating costs
    - Annual capital charges
    - Petroleum liquid credit
    - Net annual cost
- Aggregating costs to the total industry in Georgia.

Costs were determined from analyses of the following studies:

- Control of Volatile Organic Emissions from Storage of Petroleum Liquids in Fixed-Roof Tanks, EPA 450/2-77-036
- Benzene Emission Control Costs in Selected Segments of the Chemical Industry, prepared for Manufacturing Chemists Association by Booz, Allen & Hamilton Inc., June 12, 1978

and from interviews with petroleum marketers' associations, petrochemical manufacturers and vapor control equipment manufacturers.

The extrapolation of the estimated cost of control to Georgia required a profile of fixed-roof tanks for storing petroleum liquids for the state, showing the capacity of each tank. These data were provided by the Georgia Department of Natural Resources for fixed-roof tanks affected by RACT guidelines.

15.1.5 Economic Impact of Emission Control

The economic impact of emission control for equipping fixed-roof tanks used for storing petroleum liquids can be determined only in terms of the statewide cost of controls. Since several industries use fixed-roof tanks, economic impacts on individual industries depend on the extent to which the industries must bear the increased cost. The economic impact analysis in this report is, therefore, limited to estimating statewide costs of controls and qualitatively assessing the potential impacts of these costs on various industries.

15.1.6 Quality of Estimates

Several sources of information were utilized in assessing the emissions, cost and economic impact of implementing RACT controls for fixed-roof tanks in Georgia. A rating scheme is presented in this section to indicate the quality of the data available for use in this study. A rating of "A" indicates hard data (i.e., data that are published for the base year); "B" indicates data that were extrapolated from hard data; and "C" indicates data that were not available in secondary literature and were estimated based on interviews, analyses of previous studies and best engineering judgment. Exhibit 15-1, on the following page, rates each study output listed and the overall quality of the data.

EXHIBIT 15-1

U.S. Environmental Protection Agency
DATA QUALITY

Study Outputs	A Hard Data	B Extrapolated Data	C Estimated Data
Industry statistics	●		
Emissions		●	
Cost of emissions control		●	
Statewide costs of emissions		●	
Economic impact			●
Overall quality of data		●	

Source: Booz, Allen & Hamilton Inc.

15.2 TECHNICAL CHARACTERISTICS OF AND RACT GUIDELINES FOR FIXED-ROOF TANKS FOR STORING PETROLEUM LIQUIDS

The technical characteristics of fixed-roof tanks for storing petroleum liquids, the sources and types of VOC emitted by these tanks, the control measures for reducing VOC emission from fixed-roof tanks are described in the EPA guidelines series, Control of Volatile Organic Emissions from Storage of Petroleum Liquids in Fixed-Roof Tanks, EPA-450/2-77-036.

The RACT guidelines call for installation of an internal floating roof for fixed-roof tanks storing greater than 40,000 gallons of petroleum liquids with a true vapor pressure that exceeds 1.52 psi. The guidelines do not apply to storage tanks equipped with external floating roofs or to storage tanks having capacities less than 425,000 gallons used to store crude oil.

It is expected that the State of Georgia will prepare legislation for the storage of petroleum liquids which is modeled after the RACT guidelines.

15.3 PROFILE OF FIXED-ROOF TANKS FOR STORING PETROLEUM LIQUIDS AND ESTIMATED VOC EMISSIONS

This section contains a profile of fixed-roof tanks used for storing petroleum liquids having a true vapor pressure of greater than 1.52 at 100°F in the State of Georgia, and the estimated annual VOC emissions from these tanks.

The Georgia Department of Natural Resources compiled a list of fixed-roof tanks from their emissions inventory. The capacity of each tank and the type of petroleum liquid stored were provided in the listing. In summary, there are approximately 27 fixed-roof tanks with greater than 40,000 gallon capacity not equipped with an internal floating roof in the 12-county non-attainment areas, and an additional 4 large tanks with the potential for VOC emissions greater than 100 tons per year in the remainder of the state.

The total storage capacity of these tanks is 21.8 million gallons and the annual throughput of petroleum liquid is estimated to be 455 million gallons.

It is estimated that annual VOC emissions from the storage of petroleum liquids in fixed-roof tanks affected by RACT guidelines are 2,376 tons per year.

It is further estimated that these emissions could be reduced by 90 percent or to 238 tons per year by implementing RACT in Georgia.

15.4 COST OF CONTROLLING VOC EMISSIONS

This section presents a cost analysis of equipping fixed-roof tanks used for storing petroleum liquids with internal floating roofs as a means for controlling VOC emissions.

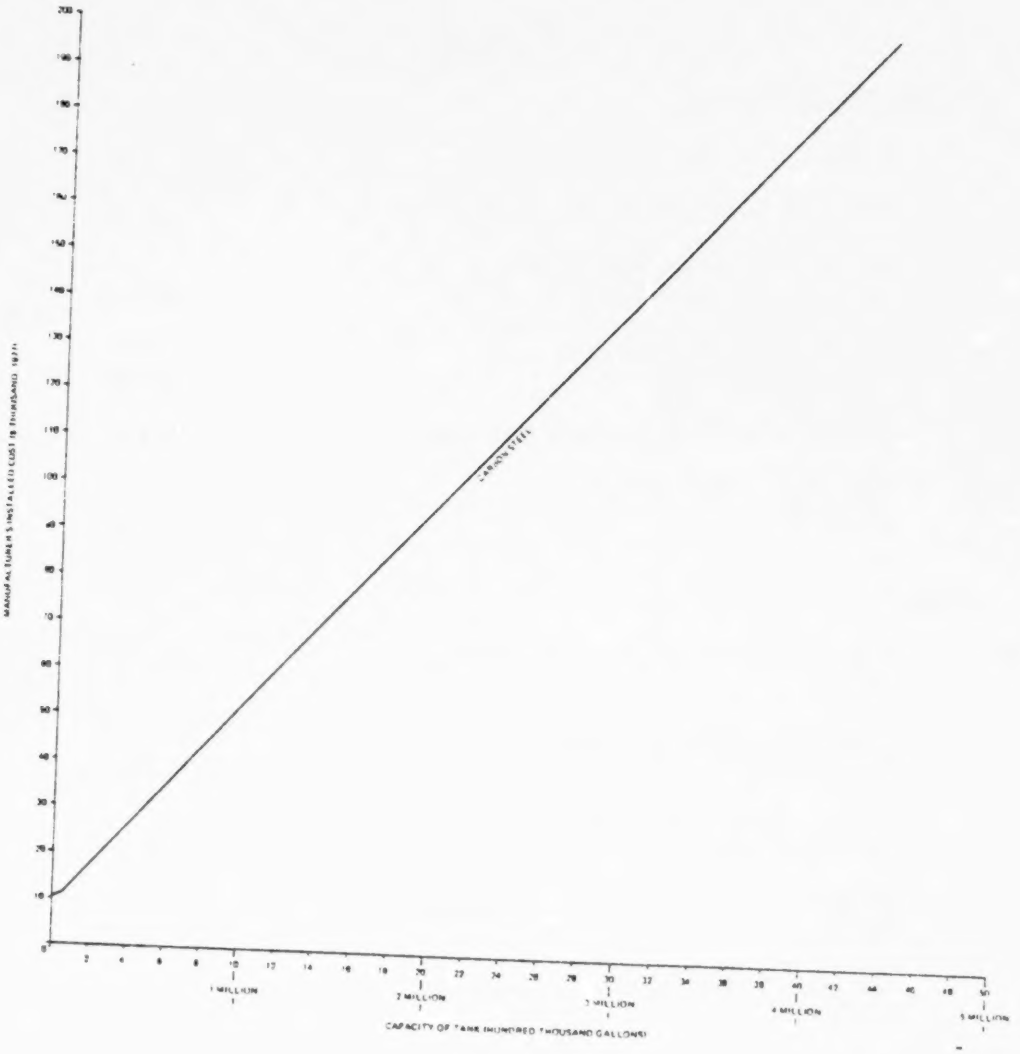
The cost factors for emission control include:

- Installed capital cost, including parts and labor
- Annual capital charges, estimated to be 25 percent of installed capital cost including costs for depreciation, interest, maintenance, taxes, and insurance
- Annualized direct operating costs, estimated to be two percent of installed capital cost including costs for inspection and recordkeeping
- Annual petroleum liquid credit, calculated by multiplying emission reduction by the volume of the petroleum liquid divided by the liquid density and multiplied by a value of $0.39 per gallon
- Net annualized costs, the sum of the capital charges and direct operating costs less the petroleum liquid credit.

Capital costs were determined for each tank from the graph in Exhibit 15-2, on the following page. This graph was prepared by Booz, Allen based on interviews with petroleum refineries, petrochemical manufacturers, tank manufacturers and emission control equipment manufacturers. Total installed capital cost, including labor, is two times the value given on the graph. All costs are for 1977.

A summary of the cost aggregated statewide from the emission control of petroleum liquids stored in fixed-roof tanks is shown in Exhibit 15-3, following Exhibit 15-2. The total installed capital costs for equipping the 31 fixed-roof tanks affected by RACT with internal floating roofs is approximately $2.11 million. The net annualized cost to the industry is approximately $307,000 taking into account an annual petroleum liquid credit of approximately $265,000. The annualized cost per ton of emissions reduced is approximately $144 per ton.

Exhibit 15-2
U.S. Environmental Protection Agency
INSTALLED COST OF SINGLE SEAL
FLOATING ROOF TANKS
(Prices Approximate)



Source: Communications with Ultra-Float Inc., Booz, Allen & Hamilton Inc. analysis

Reproduced from best available copy.

EXHIBIT 15-3
U.S. Environmental Protection Agency VOC Emissions Control Costs for Storage of Petroleum Liquids in Fixed-Roof Tanks in Georgia

SUMMARY

Plant Characteristics	
Number of tanks	31
Total capacity (millions of gallons)	21.8
Estimated annual throughput (millions of gallons)	455.1
Uncontrolled emissions (tons per year)	2,376
Emissions reduction (tons per year)	2,138
Emissions after control (tons per year)	138
Costs	
Installed capital cost ($ millions, 1977)	2.11
Annualized capital charges ($ thousands, 1977)	530
Annual direct operating costs ($ thousands, 1977)	42.2
Annual petroleum credit ($ thousands, 1977)	265[a]
Net annualized cost ($ thousands, 1977)	307
Cost per ton of emissions reduced ($ 1977)	144

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[a] Assume value of petroleum liquid saved is $0.39 per gallon and density of petroleum liquid is 6.3 lbs. per gallon.

Source: Booz, Allen & Hamilton Inc.

15.5 DIRECT ECONOMIC IMPACT

This section discusses the economic impact of equipping fixed-roof tanks used for storing petroleum liquids with internal floating roof to control VOC emissions. The impacts analyzed include: total cost statewide and identification of industries that may be affected and their ability to raise the capital needed for the controls.

- Installed Capital Costs of Compliance in Georgia. An estimated $2.11 million will be required statewide in Georgia to equip fixed-roof tanks for storing petroleum liquids with internal floating roofs.
- Industries Affected. Fixed-roof tanks affected by RACT guidelines are owned by major oil companies, large petrochemical firms and bulk gasoline tank terminal companies. It is predicted that these companies will be able to meet the capital requirements. The source of capital is likely to be the company's traditional source of funds.

15.6 SECONDARY ECONOMIC IMPACTS

It is expected that secondary economic impacts as a result of implementing RACT guidelines in Georgia will be minimal. Employment, worker productivity, and market structure should remain unchanged.

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Exhibit 15-4 on the following page presents a summary of the findings of this report.

EXHIBIT 15-4

U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR STORAGE OF PETROLEUM LIQUIDS IN THE STATE OF GEORGIA

Current Situation	Discussion
Number of potentially affected Storage tanks	31
Indication of relative importance of industrial section to state economy	The annual throughput was an estimated 455 million gallons
Current industry technology trends	Internal floating roof tanks utilizing a double seal have been proven to be more cost effective
VOC emissions	2,138 tons per year
Preferred method of VOC control to meet RACT guidelines	Single seal and internal floating roof
Affected Areas in Meeting RACT	
Capital investment (statewide)	$2.11 million
Annualized cost (statewide)	$0.3 million
Price	Assuming a "direct cost pass-through—— less than 0.1 cents per gallon of throughput
Energy	Assuming 90 percent reduction of current VOC level, the net energy savings represent an estimated savings of 17,000 equivalent barrels of oil annually
Productivity	No major impact
Employment	No major impact
Market Structure	No major impact
Problem area	Potential availability of equipment to implement RACT standard
VOC emission after control	238 tons per year
Cost effectiveness of control	$144 annualized cost/annual ton of VOC reduction

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Source: Booz, Allen & Hamilton Inc.

BIBLIOGRAPHY

Benzene Emission Control Cost in Selected Segments of the Chemical Industry, prepared for Manufacturing Chemists Association by Booz, Allen & Hamilton Inc., June 12, 1978.

Control of Volatile Organic Emissions from Storage of Petroleum Liquids in Fixed-Roof Tanks, EPA-450/2-77-036, U.S. Environmental Protection Agency, December 1977.

Regulatory Guidance for Control of Volatile Organic Compound Emissions from 15 Categories of Stationary Sources, EPA-905/2-78-001, U.S. Environmental Protection Agency, April 1978.

Revision of Evaporative Hydrocarbon Emission, PB-267 659, Radian Corp., August 1976.

16.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT STAGE I FOR GASOLINE SERVICE STATIONS IN THE STATE OF GEORGIA

This chapter presents a detailed analysis of implementing RACT Stage I controls pertaining to gasoline dispensing facilities[a] in the state of Georgia. Presently, only twelve counties in Georgia are classified as non-attainment areas. They are: Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Fulton, Gwinnett, Henry, Muscogee (Columbus), Paulding and Rockdale. The impact of RACT in these counties is investigated in six sections as follows:

- Specific methodology and quality of estimates
- Industry statistics
- The technical situation of the industry
- Cost and hydrocarbon reduction benefit evaluations for Stage I RACT requirements
- Direct economic implications
- Selected secondary economic impacts.

Each section presents detailed data and findings based on analyses of the RACT guidelines, previous studies of gasoline service station vapor recovery, interviews and analysis.

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[a] Gasoline dispensing facility is a generic term which encompasses both retail facilities and private outlets. The latter are primarily establishments maintained by governmental, commercial or industrial consumers for their own fleet operations. The latter category also includes rural convenience stores, parking garages, marinas and other retail outlets not classified as service stations.

16.1 SPECIFIC METHODOLOGY

This section describes the methodology for determining estimates of:

- Industry statistics
- VOC emissions
- Processes for controlling VOC emissions
- Cost of controlling VOC emissions
- Economic impact of emission control

for gasoline dispensing facilities in the State of Georgia.

The quality of the estimates based on a three point scale is described in detail in the latter part of this section.

16.1.1 Industry Statistics

The focal year of the analysis is 1977 and all hard industry statistics are reported on this basis. When hard data for the base year are not available, appropriate scaling factors are applied to existing confirmed data to derive base year estimates.

To derive the total number of gasoline dispensing facilities in the twelve non-attainment counties a two-stage procedure is used. First, the number of statewide retail service stations is identified[a] and the figure is then scaled by a factor of 1.37[b] to produce an estimate of the number of private dispensing facilities. Next, these two statewide totals are disaggregated to the county level using coefficients developed from a Bureau of Census publication.[c] In addition to providing a basis for estimating the total number of dispensing facilities at the county level, the census publication is also used to calculate total county employment levels.

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[a] National Petroleum News Fact Book, 1978, p. 105.

[b] The Economic Impact of Vapor Recovery Regulations on the Service Station Industry, Department of Labor, OSHA, C79911, March 1978, pp. 4-7.

[c] County Business Patterns 1976 : Georgia U.S. Department of Commerce, CBP-76-12, 1978.

Finally, to derive the volume of gasoline sold in the non-attainment counties, existing data on state sales totals[d] are disaggregated using coefficients reflecting the ratio of county establishments to state establishments. A value is assigned to this sales volume using the 1977 average national service station price (50.7¢/gal. excluding tax.)[e]

16.1.2 VOC Emissions

The Illinois EPA estimated VOC emissions for gasoline service stations by applying an emission factor to the 1977 gasoline throughput. This emission factor and procedure were used to calculate emissions in Georgia.

16.1.3 Processes for Controlling VOC Emissions

Processes for controlling VOC emissions from gasoline service stations are described in "Design Criteria for Stage I Vapor Control Systems Gasoline Service Stations." This document provides the base data on alternative methods available for controlling VOC emissions from gasoline service stations. In addition, several studies of VOC emission control were analyzed and interviews with petroleum trade associations, gasoline service operators and vapor control equipment manufacturers were conducted, to ascertain the most likely types of equipment which would be used in gasoline service stations in Georgia. The specific studies analyzed were: "Economic Impact of Stage II Vapor Recovery Regulations: Working Memoranda," EPA-450/3-76-042; "A Study of Vapor Control Methods for Gasoline Marketing Operations," PB-246-088, Radian Corporation; "Reliability Study of Vapor Recovery Systems at Service Stations," EPA-450/3-76-001; "Technical Support Document Stage I Vapor Recovery at Service Stations," draft, Illinois Environmental Protection Agency.

16.1.4 Cost of Vapor Control Systems

The costs of vapor control systems were developed by:

- Developing costs of two different control systems for a model service station including:

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[d] Federal Highway Administration Forms, NF 25, 26, 21.

[e] National Petroleum News Fact Book, 1978, p. 100.

  - Installed capital cost
  - Direct operating costs
  - Annual capital charges
  - Gasoline credit
  - Net annual cost

- Aggregating costs to the countywide gasoline dispensing establishment industry.

Costs were determined from analyses of the studies listed previously, and from interviews with petroleum marketers' associations, gasoline service station operators and vapor control equipment manufacturers.

It was assumed that 75 percent of the gasoline dispensing facilities would install coaxial or concentric vapor balance systems and the remaining 25 percent would install the two point vapor balance system. Costs for the two systems are assumed to be represented by the costs developed for the model service station discussed in Section 16.4.1. Non-attainment county costs were extrapolated from model costs.

16.1.5 Economic Impacts

The economic impacts were determined by analyzing the lead time requirements needed to implement RACT; assessing the feasibility of instituting RACT controls in terms of capital and equipment availability; comparing the direct costs of RACT control to various county economic indicators; and assessing the secondary impacts on market structure, employment and productivity resulting from implementation of RACT controls.

16.1.6 Quality of Estimates

Several sources of information were utilized in assessing the emissions, costs, and economic impact of implementing RACT controls on gasoline service stations. A rating scheme is presented in this section to indicate the quality of the data available for use in this study. A rating of "A" indicates hard data (i.e., data that are published for the base year); "B" indicates data that were extrapolated from hard data; and "C" indicates data that were not available in secondary literature and were estimated based on interviews, analyses of previous studies and best engineering judgment. Exhibit 16-1, on the following page, rates each study output and the overall quality of the data.

EXHIBIT 16-1
U.S. Environmental Protection Agency
DATA QUALITY

Study Outputs	A Hard Data	B Extrapolated Data	C Estimated Data
Industry statistics	●		
Emissions		●	
Cost of emissions control		●	
Countywide costs of Emissions			●
Economic impact		●	
Overall quality of data		●	

Source: Booz, Allen & Hamiliton Inc.

16.2 INDUSTRY STATISTICS

Industry characteristics, statistics and business trends for gasoline service stations are presented in this section. The discussion includes a description of the number of facilities and their characteristics, a comparison of the size of the service station industry to state economic indicators, a historical characterization and description of the industry and an assessment of future industry patterns. Data in this section form the basis for assessing the impact on this industry of implementing RACT to VOC emissions from gasoline service stations in Georgia.

16.2.1 Size of Industry

There were an estimated 1,825 retail gasoline dispensing facilities in the twelve counties in Georgia in 1977. In addition, there were an estimated 2,500 private dispensing establishments (which include gasoline dispensing facilities such as marinas, general aviation facilities, commercial and industrial gasoline consumers and rural operations with gas pumps). For all dispensing facilities sales were in the range of $529 million and yearly throughput was approximately 1.04 billion gallons of gasoline. The estimated number of employees in 1977 was 9,377 employees in retail outlets and 5,000 employees in private outlets for a total of 14,377 employees. These data and the sources of information are summarized in Exhibit 16-2, on the following page. Total capital investments by the gasoline dispensing industry were not identified, although in general gasoline dispensing outlet operators make investments in plant and equipment to replace worn-out facilities and equipment; modernize the establishments; or improve operating efficiencies.

16.2.2 Comparison of Industry to State Economy

Employment and sales are used as reference indicators in order to gain a perspective on the economic significance of the gasoline dispensing industry. The estimated 14,377 employees and $529,000,000 in sales constitute approximately one percent of the civilian labor force and seven percent of the total twelve county retail trade in 1977. In evaluating these percentages, it should be remembered that transportation is a vital linking element in the economy

EXHIBIT 16-2

U.S. Environmental Protection Agency
INDUSTRY STATISTICS FOR GASOLINE SERVICE STATIONS IN GEORGIA

Number of Facilities		Number of Employees			
Retail Dispensing Facilities	Private Dispensing Facilities	Retail	Private	Sales (\$Billion, 1977)	Gasoline Sold (Billions of Gallons)
1,825[a]	2,500[b]	9,377[c]	5,000[d]	0.529[e]	1.04[f]

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a. *National Petroleum News Fact Book*, 1978.

b. Includes gasoline dispensing facilities such as marinas, general aviation facilities, commercial and industrial gasoline consumers and rural convenience store operations with gas pumps.

c. Estimate based on the ratio of the number of employees to the number of establishments (scaled appropriately) in the twelve counties as of 1976.

Clayton	6.47	employees per retail outlet
Cobb	4.94	"
Coweta	3.51	"
DeKalb	5.95	"
Douglas	5.34	"
Fayette	5.17	"
Fulton	4.89	"
Gwinnett	3.98	"
Henry	3.6	"
Paulding	5.45	"
Rockdale	6.25	"
Muscogee (Columbus)	4.64	"

(Source: U.S Department of Commerce, Bureau of the Census, *County Business Patters 1976*): Georgia CBP-76-12, 1978

d. Estimate based on two employees per facility.

e. Number of gallons of motor gasoline sold in 1977 multiplied by the national service station price in 1977 (50.7¢/gallon), *National Petroleum News Fact Book*, 1978.

f. Estimated based on Federal highway statistics for 1977.

Source: Booz, Allen & Hamilton Inc.

and any significant disruption to the gasoline dispensing sector could have indirect consequences for other sectors of the economy.

16.2.3 Characterization of the Industry: Structure and Trends

Gasoline dispensing establishments are the final distribution point in the petroleum marketing network. Exhibit 16-3 shows the position of both retail and private dispensing facilities with the former located in the bottom row and the latter primarily in the source marked "Commercial/Industrial Consumer Accounts." As the graphic indicates, all petroleum marketers retail their gasoline through one of the following type operations:

- Direct-salary operation: supplier "controlled"/ supplier-operated
- Lessee dealer: supplier-"controlled"/lessee-dealer operated
- Open dealer: dealer-"controlled"/dealer-operated
- Convenience Store

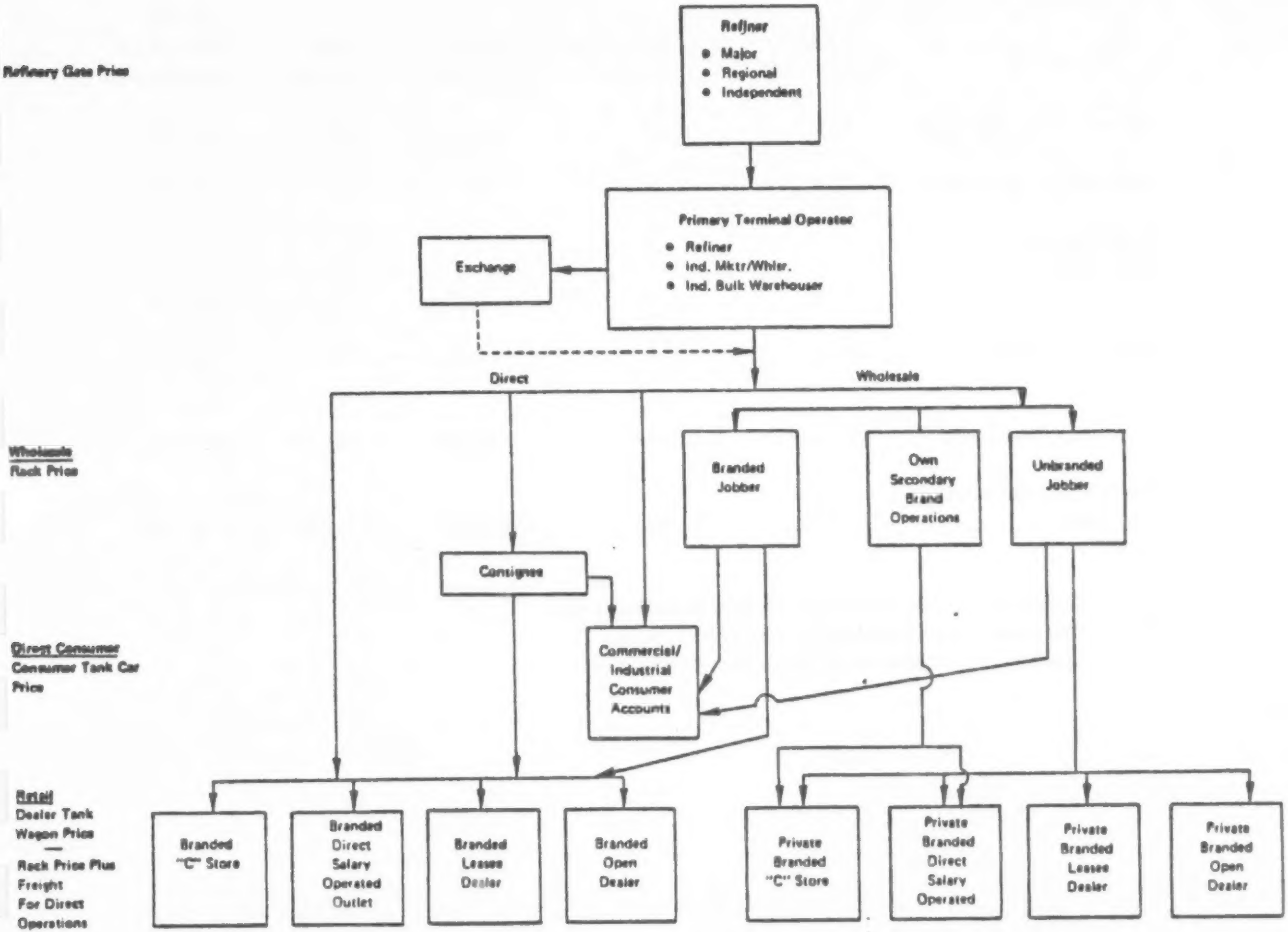
According to this classification, the retail gasoline dispensing sector has the following dimensions: 18 percent direct outlets, 5.4 percent convenience stores, 46.9 percent lessee dealers and 29.7 percent open dealers. See Exhibit 16-4 for more details.

By way of contrast, the private dispensing establishments have the following breakdown by end use: agriculture trucking and local service, government, taxis, school busses, and miscellaneous. See Exhibit 16-5 for more details.

Regardless of ownership pattern or end use category, gasoline marketing is characterized by high fixed costs, with operations varying by degree of labor intensity. Conventional service stations (service bay with mechanics on duty and nongasoline automotive items available) are the most labor intensive, while self-service "gas and go" stations exemplify low labor intensity.

Finally, no discussion of the industry would be complete wihtout a characterization of major trends. The number of gasoline dispensing facilities, and in particular

EXHIBIT 16-3
U.S. Environmental Protection Agency
GASOLINE DISTRIBUTION NETWORK


Refinery Gate Price
Wholesale
Rack Price
Direct Consumer
Consumer Tank Car Price
Retail
Dealer Tank Wagon Price
Rack Price Plus Freight For Direct Operations
Refiner
• Major
• Regional
• Independent
Primary Terminal Operator
• Refiner
• Ind. Mktr/Whlsr.
• Ind. Bulk Warehouser
Exchange
Direct
Wholesale
Branded Jobber
Own Secondary Brand Operations
Unbranded Jobber
Consignee
Commercial/ Industrial Consumer Accounts
Branded "C" Store
Branded Direct Salary Operated Outlet
Branded Lessee Dealer
Branded Open Dealer
Private Branded "C" Store
Private Branded Direct Salary Operated
Private Branded Lessee Dealer
Private Branded Open Dealer

Source: U.S. Department of Labor, The Economic Impact of Vapor Recovery Regulations on the Service Station Industry, c-79911, March 1978, p. 56.

EXHIBIT 16-4
U.S. Environmental Protection Agency
U.S. RETAIL GASOLINE DISPENSING FACILITIES

% TOTAL OUTLETS

	Direct Outlets[a]	Convenience Stores	Lessee Dealer[b]	Open Dealer[c]	Total Directly Supplied
Major Oil Company	3.5	0.4	28.2	15.7	47.8%
Regional Refiner	2.3	0.1	5.3	1.1	8.8%
Independent Marketer	9.3	4.3	2.5	0.6	16.7%
Small Jobber	2.9	0.6	10.9	12.3	26.7%
% Total Outlets	18.0%	5.4%	46.9%	29.7%	100.0%
Total Number of Outlets	32,070	9,600	83,690	53,030	178,390

[a] Company "investment"/company operated
[b] Company "investment"/lessee dealer
[c] Dealer "investment"/dealer operated

Source: U.S. Department of Labor "The Economic Impact of Vapor Recovery Regulations on the Service Station Industry," C-79911, March 1978, p. 58.

EXHIBIT 16-5
U.S. Environmental Protection Agency
U.S. PRIVATE GASOLINE DISPENSING FACILITIES

End-Use Sector	Number of "Private" Gasoline-Dispensing Outlets	Annual Gasoline Consumption (Million Gal)	% Total U.S. Private Gasoline Volume	% Total U.S. Gasoline Volume
Agriculture	32,600	3,801.3	15%	3%
Trucking and local service	21,900	5,241.6	21%	5%
Government	85,450		11%	2%
- Federal		227.6	0.9%	
- Military		174.1	0.6%	
- Other*		2,266.4	9.0%	
Taxis	5,380	882.1	3%	0.8%
School Busses	3,070	144.7	1%	0.1%
Miscellaneous**	94,530	12,497.2	49%	11%
Total Non-Service Station Segment	242,930	25,235.0	100%	23%
Retail Service Station Segment	178,390	84,412.0		77%
All Segments —	421,320	109,647.0		100%

*State and municipal governments.

**Auto rental, utilities, and other.

Source: U.S. Department of Labor, "The Economic Impact of Vapor Recovery Regulations on the Service Station Industry," C-79911, March 1978, p. 47.

the retail service stations, has been declining nationally since 1972. At the same time, throughput per station has been rising, reflecting the switch to high volume self-service "gas and go" establishments.[a] This trend also appears in Georgia and is predicted to continue. In 1972 there were 6,730 service stations and in 1977 this number fell to 5,243.[b]

16.2.4 Gasoline Prices

Gasoline prices vary among types of gasoline stations within a geographical area. Convenience stores are apt to have higher pump prices than large self-service "gas and go" stations. The pump price less the dealer tank wagon price represents the gross margin on a gallon of gasoline. Retail gasoline service station operating costs then must come out of the gross margin for gasoline as well as the gross margin for other products which may be sold at the service station. Operating costs vary substantially among the various types of service stations. It is reported that some service stations operate with nearly zero net margin or profit on the sale of gasoline, while others may enjoy up to four to five cents profit per gallon. Insufficient detail is available on service stations in Georgia to present a thorough analysis of existing price structures and degree of competition in the industry within the state.

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[a] "Economic Impact of Stage II Vapor Recovery Regulations: Working Memoranda," EPA-450/3-76-042, November 1976, p. 2. By 1980 one-half of all retail gasoline stations are expected to be self-service.

[b] National Petroleum News Fact Book, 1978, p. 105.

16.3 THE TECHNICAL SITUATION IN THE INDUSTRY

This section presents information on gasoline dispensing outlet operations, estimated VOC emissions from these operations in the non-attainment areas, the extent of current control in use, the vapor control requirements of RACT and the likely alternatives which may be used for controlling VOC emissions from gasoline dispensing facilities in Georgia.

16.3.1 Gasoline Dispensing

Gasoline service stations are the final distribution point in the gasoline marketing network. Taking retail and private outlets together, the average monthly throughput per station in the twelve counties is 20,096 gallons. These facilities are all subject to RACT regulations and will be required to comply with Stage I vapor control by January 1, 1982.

16.3.1.1 Facilities

Equipment at gasoline dispensing facilities include: gasoline storage tanks, piping and gasoline pumps. The most prevalent type of gasoline storage tank is the underground tank. It was assumed that there are typically three storage tanks per facility. Gasoline is dispensed to motor vehicles through pumps and there may be anywhere from one to twenty pumps per facility. Stage I vapor control regulations apply to the delivery of gasoline to the facility and the subsequent storage in underground tanks.

16.3.1.2 Operations, Emissions and Controls

Uncontrolled VOC emissions at dispensing facilities come from loading and unloading losses from tank trucks and underground tanks, refueling losses from vehicle tanks and breathing losses from the underground tank vent. Stage I vapor control applies to tank truck unloading and working, and breathing losses from underground storage tanks.

Tank trucks are unloaded into underground storage tanks either by splash loading or submerged loading. Splash loading results in more emissions than submerged loading.

More specifically, losses consist of:

- Organic liquid that evaporates into the air that is drawn in during the withdrawal of the tank compartment contents
- losses from refilling the underground tank that occur as vapors are displaced from the tank
- vapors vented into the atmosphere from underground storage tanks as a result of changes in temperature and pressure

Exhibit 16-6 shows the estimated emissions in tons per year from all dispensing facilities in non-attainment counties. To arrive at this estimate it is assumed that 90 percent[a] of all storage tank loading is by the submerge fill method and 10 percent by the splash fill method. Given this assumption, emissions based on throughput are estimated to be 4,026 tons.

16.3.2 RACT Guidelines

The RACT guidelines for Stage I VOC emission control from gasoline service stations require the following controls:

- Submerged fill of gasoline storage tanks
- Vapor balancing between the truck and the gasoline storage tank
- Proper operation and maintenance of equipment.

Exhibit 16-7 summarizes the RACT guidelines for VOC emissions control from gasoline service stations.

16.3.3 Selection of the Most Likely RACT Control Techniques

State I control of VOC emissions from gasoline dispensing facilities can be achieved by using vapor balancing between the unloading of incoming tank trucks and the gasoline storage tank and by submerged filling of storage tanks. There

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[a] Source: Booz, Allen interviews with industry representatives.

EXHIBIT 16-6
U.S. Environmental Protection Agency
VOC EMISSIONS FROM GASOLINE

Estimated Number of Facilities	Average Yearly Throughput (Millions of Gallons)	Total Emissions[a] (Tons/Year)
4,325	1,043	4,026

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[a] Splash fill emissions: 11.5 lbs/1000 gallons throughput
Submerge fill emissions: 7.3 lbs/1000 gallons throughput
assumes no vapor balancing

Source: Illinois Environmental Protection Agency

EXHIBIT 16-7

U.S. Environmental Protection Agency
VOC EMISSION CONTROL TECHNOLOGY FOR GASOLINE DISPENSING FACILITIES

Facilities Affected	Sources of Emissions	RACT Control Guidelines
Gasoline service stations and gasoline dispensing facilities	Storage tank filling and unloading tank truck	Stage I vapor control system, i.e., vapor balance system which returns vapors displaced from the storage tank to the truck during storage tank filling, and submerge filling; instructions to operator of facility on maintenance procedures; repair and replacement of malfunctioning or worn equipment; maintenance of meters and test devices

Source: "Regulatory Guidance for Control of Volatile Organic Compound Emissions from 15 Categories of Stationary Sources," pp. 28-31.

are alternative means of achieving vapor balance, based primarily on the method of connecting the vapor return line to the gasoline storage tank. The two primary methods for connecting vapor return lines are the two point connection and coaxial or concentric connection (often referred to as tube-in-tube connection). The two point connection method involves using two risers with the storage tank: one for fuel delivery and the other for returning vapors to the tank truck. The coaxial system uses a concentric liquid vapor return line and thus requires only one tank riser. EPA tests have shown the two point system to be more effective than the coaxial system in transferring displaced vapors, but at the same time the two point system is more expensive. It is judged that 25 percent of gasoline dispensing facilities will install the two point system,[1] bearing a higher installed cost but achieving greater efficiency. Submerged fill is required by Stage I vapor control. It is achieved by using a drop tube extending to within six inches of the storage tank bottom.

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[1] Booz, Allen interviews with industry personnel

16.4 COST AND HYDROCARBON REDUCTION BENEFIT EVALUATIONS FOR STAGE I RACT REQUIREMENTS

Costs for VOC emission control equipment are presented in this section. The costs for a typical gasoline service station are described, followed by an extrapolation to the non-attainment county industry.

16.4.1 Costs for Vapor Control Systems

The costs for vapor control systems were developed from information provided by petroleum marketing trade associations and from previous cost studies of gasoline dispensing facilities. These costs are summarized for a typical gasoline dispensing facility in Exhibit 16-8. The monthly throughput of affected facility averages out at 36,500 gallons or 2,500 gallons less than the average for all retail facilities in the United States.[a] Though Georgia facilities are somewhat below the U.S. average, in general, service station equipment requirements (number of storage tanks) are not very sensitive to throughput over a large gallon range. Therefore, it appears that Georgia facilities should be quite similar to the prototype facility described in Exhibit 16-8. Given this observation, Stage I vapor control costs have been estimated as follows.

Capital costs of installing the two point vapor-balancing equipment at existing service stations are about $2,000 per station. This cost includes equipment costs ($300-$500) and installation ($1,300-$1,600).[b] The installed capital cost for a coaxial or concentric system is reported by U.S. EPA to be $150 to $200 per tank, including parts and labor. Annualized capital costs are estimated at 25 percent of installed capital cost and include interest, depreciation, taxes and maintenance.

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[a] U.S. Department of Labor, OSHA, "The Economic Impact of Vapor Recovery Regulations on the Service Station Industry," C-79911, March 1978, p. 29.

[b] "Air Pollution Control Technology Applicable to 26 Sources of Organic Compounds," U.S. Environmental Protection Agency, May 27, 1977. (This cost includes excavation and construction of manifolded storage tanks.)

EXHIBIT 16-8
U.S. Environmental Protection Agency
STAGE I VAPOR CONTROL COSTS FOR A TYPICAL RETAIL GASOLINE DISPENSING FACILITY

Description of Model Gasoline Station

Monthly throughput (gallons)	39,000[a]
Number of storage tanks	3[b]

Costs
($, 1977)

	Two Point System	Coaxial or Concentric System
Installed capital	2,000[c]	600
Annualized capital charges[d]	500	150
Direct operating cost	0	0
Annualized cost[e]	500	150

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[a] 39,000 is the national average. In Georgia's non-attainment counties the average is 36,500 for retail dispensing outlets and 7910 for private outlets.

[b] In private dispensing outlets, the number of tanks is assumed to be one as opposed to three On the average, private stations have monthly throughput flows of only 22 percent of throughput in retail service stations.

[c] Includes cost of repaving but does not account for lost sales due to down time.

[d] Twenty-five percent of installed capital cost. Includes depreciation, interest, taxes, insurance and maintenance.

[e] Does not include credit for recovered gasoline.

Source: Booz, Allen & Hamilton Inc.

Based on these figures, the annualized cost[a] at a typical gasoline dispensing facility with 36,500 gallons/month throughput is estimated to be $500 for the two point system and $150 for the concentric or coaxial system. It is worth noting that direct operating costs should not increase due to Stage I controls and thus the annualized cost will reflect only the capital changes associated with the control equipment.

In addition to the cost incurred at the gasoline dispensing facility, there are also the costs of vapor balancing borne by the owners of the tank trucks. The costs to bulk gas plants and terminals of Stage I vapor modifications of fleet trucks have been discussed in other chapters. Here the focus is on independent fleet operators subject to RACT vapor controls. By approximating the total number of tank trucks needed to service the gasoline dispensing facilities in the non-attainment counties, and by subtracting from this total the estimated number of trucks controlled by bulk terminals and gas plants, the size of the independent fleet is derived. Booz, Allen estimates that 25 percent of the total fleet is independent, and this translates roughly into 70 tank trucks requiring vapor modification at a total cost of $210,000.

The cost of vapor control modification on trucks is estimated to be between $2,000 and $7,200 depending on whether top or bottom loading methods are used. For purposes of this analysis, it is assumed that the less expensive top loading method will be used, and that this system can be installed at a cost of $3,000 per truck. Annualized capital costs are estimated at 25 percent of installed capital cost and include: interest, depreciation, taxes and maintenance. Direct operating costs are assumed to be zero. See Exhibit 16-9 on the following page for more details.

16.4.2 Extrapolation to the Industry in Non-Attainment Areas

Exhibit 16-10 shows the extrapolation of vapor control costs to the countywide industry. Costs include truck modifications and vapor control at the gasoline dispensing facilities. It should be noted that actual costs to the operators of trucks and gasoline dispensing outlets may vary depending on the control method and specific equipment selected.

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[a] Gasoline recovery credit has not been accounted for here, but will be when the results are extrapolated to the county-wide industry.

EXHIBIT 16-9
U.S. Environmental Protection Agency
STAGE I VAPOR CONTROL COSTS FOR A TYPICAL GASOLINE DISPENSING TRUCK

	Costs for Top Loading Method ($, 1977)
Installed capital[a]	3,000
Annualized capital charges[b]	750
Direct operating cost	0
Annualized cost	750

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[a] Booz, Allen interviews with equipment manufacturers.

[b] 25 percent of installed capital cost. It includes depreciation, interest, taxes, insurance and maintenance.

Source: Booz, Allen & Hamilton Inc.

EXHIBIT 16-10

U.S. Environmental Protection Agency
NON-ATTAINMENT AREA COSTS FOR STAGE I VAPOR CONTROL OF GASOLINE DISPENSING FACILITIES

SUMMARY OF COSTS

Number of facilities	4,325
Total annual throughput (billions of gallons)	1.043
Uncontrolled emissions (tons/year)	4,026
Emissions reduction (tons/year)	3,825[a]
Uncontrolled emissions (tons/year)	201
Installed capital ($ millions)	2.742
. dispensing facilities	2.532
. tank trucks	0.210
Annualized capital cost ($ millions)	0.686
. dispensing facilities	0.633
. tank trucks	0.053
Annual gasoline credit ($ millions)	0.036[b]
Net annualized cost ($ millions)	0.650
Net annual cost per ton of emission reduced ($ per ton/year)	$170

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[a] Estimate based on 95 percent reduction in emissions.

[b] Gasoline credit to dispensing outlets is based on the conversion from splash to submerged filling. The actual formula relates throughput in splash fill facilities to potential captured vapors resulting from equipment conversion, and values the recoverable gasoline at its retail selling price (50.7¢/gallon). Bulk terminals also receive a gasoline credit for the recovered vapors brought back by tank trucks. This gasoline is estimated to be worth $500,000 when valued at the bulk wholesale price (42¢/gallon).

__Source__: Booz, Allen & Hamilton Inc.

The total cost to the industry of installing vapor control equipment is estimated to be approximately $2,740,000. The amount of gasoline prevented from vaporizing by converting to sumberged filling of the gasoline storage tank is estimated to be worth approximately $36,000. Based on these estimates, the annual cost per ton of emissions controlled was $170 per ton.

16.5 DIRECT ECONOMIC IMPLICATIONS

This section discusses the direct economic implications for the non-attainment counties of implementing Stage I RACT controls.

16.5.1 RACT Timing

RACT must be implemented statewide by January 1, 1982.[a] This means that gasoline service station operators must have vapor control equipment installed and operating within the next three years. The timing deadlines of RACT impose several requirements on service station operators including:

- Determining the appropriate method of vapor balancing
- Raising capital to purchase equipment
- Generating sufficient income from current operators to pay the additional annual operating costs incurred with vapor control
- Acquiring the necessary vapor control equipment
- Installing and testing vapor control equipment to insure that the system complies with RACT.

16.5.2 Feasibility Issues

Technical and economic feasibility issues of implementing RACT controls are discussed in this section.

Gasoline service stations in several air quality control regions of the U.S. have successfully implemented Stage I vapor control systems.

State adoption of Stage I RACT regulations will generate additional demand for the vapor control systems for gasoline service stations. However, it is estimated that off-the-shelf systems will be readily available within the next three years, thus making the implementation of Stage I RACT technically feasible.

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[a] The deadline actually begins October 1, 1980, but mandatory compliance will probably not be enforced until 1982.

A number of economic factors are involved in determining whether a specific establishment will be able to implement vapor control systems and still remain profitable. These include:

- Ability to obtain financing
- Ownership—major oil company or private individual
- Ability to pass on a price increase
- The current profitability of the establishment
- Age of the establishment.

A major finding in a study on gasoline service station vapor control was that small service stations could have problems raising the necessary capital to purchase and install vapor control equipment. The inability to raise the necessary capital to install vapor control equipment could cause the closing of some service stations.[a]

Service stations that are owned by major oil companies may have better access to capital than privately owned service stations. A private service station owner may have to borrow capital from local banks, friends or relatives, whereas a station owned by a major oil company may receive funding out of the oil company's capital budget.

It is estimated that small gasoline service stations with throughput less than 10,000 gallons[b] per month will experience a cost increase of nearly 0.25 cents per gallon to implement RACT, using the two point vapor balance system. Larger service stations will experience a cost increase only one-fifth as much. This will put the smaller stations at a competitive disadvantage in terms of passing on a price increase.

Recent experience indicates that temporary disruption due to Stage I RACT control can have serious impacts on the service stations' profitability. In an interview, the Greater Washington/Maryland Service Station Association reported that several service stations experienced a loss of business for up to three weeks while Stage I vapor control was being installed. Service station driveways were torn up, greatly restricting access to pumps. In some instances, oil company owned service stations were sold or closed down because the oil companies did not want to expend funds for vapor control at these marginally profitable operations.

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[a] "Economic Impact of Stage II Vapor Recovery Regulations: Working Memoranda," EPA-450/3-76-042, November 1976.

[b] The EPA may exempt service stations with throughput less than 10,000 gallons per month from the RACT requirements.

The older service stations reportedly will experience greater costs than new service stations when implementing Stage I vapor control requirements. This is because older stations will have more extensive retrofit requirements and will probably experience more temporarily lost business during the retrofit.

The number of gasoline service stations have been declining nationally over the past few years for a number of reasons, reflecting a trend towards reducing overhead costs by building high throughput stations. This trend is likely to continue whether or not vapor control is required. Implementation of Stage I RACT control may simply accelerate this as marginal operators may opt not to invest in the Required capital equipment. Sufficient data for Georgia are not available to quantify the magnitude of this impact.

16.5.3 Comparison of Direct Cost With Selected Direct Economic Indicators

The net increase in the annual operating cost to the gasoline service stations industry from RACT represents 0.14 percent of the value of the total gasoline sold in the non-attainment counties. Compared to the county-wide value of retail trade, this annual cost increase would be insignificant. The impact on the unit price of gasoline varies with the gasoline service station throughput. As discussed in the preceding section, the small stations, with less than 10,000 gallons per month throughput, may experience an annulaized cost increase of up to 0.25 cents per gallon of gasoline sold, whereas the large service stations may experience an annualized cost increase only one-fifth as large.

16.6 SELECTED SECONDARY ECONOMIC IMPACTS

This section discusses the secondary impact of implementing RACT on employment, market structure, and gasoline station operation.

Employment is expected to decline, if a number of small marginally profitable gasoline service stations cease operating rather than invest capital for compliance with RACT. Based on the county-wide estimates of number of employees and the number of facilities, approximately three jobs will be lost with the closing of each gasoline dispensing outlet. No estimate was made of the total number of facilities that may close due to RACT.

The market structure is not expected to change significantly because of Stage I vapor control requirements. The dominant industry trend is towards fewer stations with higher throughputs. This trend will continue with or without RACT. Those marginal facilities which do close because of RACT will merely enhance the existing industry trend towards greater concentration.

The impact on a specific service station operation is expected to be slight. Fill rates for loading gasoline storage tanks may marginally decline if coaxial or concentric vapor hose connections are used.

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Exhibit 16-11, on the following page, presents a summary of the findings of this report.

EXHIBIT 16-11(1)
U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR GASOLINE DISPENSING FACILITIES IN THE STATE OF GEORGIA

Current Situation	Discussion
Number of potentially affected facilities	4,325
Indication of relative importance of industrial sector to county economy	12 county industry sales are $529 million with a yearly throughput of 1.04 billion gallons
Current industry technology trends	Number of stations has been declining and throughput per station has been increasing. By 1980, one-half of stations in U.S. are predicted to become totally self-service
1977 VOC emissions (actual)	4,026 tons per year from tank loading operation
Industry preferred method of VOC control to meet RACT guidelines	Submerged fill and vapor balance
Assumed method of control to meet RACT guidelines	Submerged fill and vapor balance

Affected Areas in Meeting RACT	Discussion
Capital investment (12 counties)	$2.7 million
Annualized cost (12 counties)	$0.686 million (less than 0.1 percent of the value of gasoline sold)
Price	Assuming a "direct cost pass-through"--less than $0.001 per gallon of gasoline sold in the 12 counties
Energy	Assuming full recovery: 1,234,000 gallons/year (24,919 equivalent barrels of oil) saved[a]
Productivity	No major impact
Employment	No major impact
Market structure	Compliance requirements may accelerate the industry trend towards high throughput stations (i.e., marginal operations may opt to shut down)

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[a] One gallon of gasoline has 125,000 BTU's. One barrel of oil equivalent has 6,050,000 BTU's.

EXHIBIT 16-11(2)
U.S. Environmental Protection Agency

RACT timing requirements (1982)	Retrofitting all service stations within time constraints may be difficult in a few instances
Problem area	Older stations face higher retrofit costs--potential concerns are dislocations during installations
VOC emission after RACT control	201 tons per year from tank loading operation
Cost effectiveness of RACT control	$170 annualized cost/annual ton of VOC reduction

Source: Booz, Allen & Hamilton Inc.

BIBLIOGRAPHY

National Petroleum News Fact Book 1978, McGraw-Hill.

The Economic Impact of Vapor Recovery Regulations on the Service Station Industry, Department of Labor, OSHA, C79911 March, 1978.

County Business Patterns 1976: South Carolina, U.S. Department of Commerce, CBP-76-12, 1978.

Economic Impact of Stage II Vapor Recovery Regulation: Working Memoranda, EPA-450/3-76-042, November, 1976.

Federal Highway Administration: Mr. Ken Toda.
Table MF 25: Private and Commercial Highway Use of Special Fuels by Months, 1977.
Table MF 26: Highway Use of Gasoline by Months, 1977.
Table MF 21: Motor Fuel Use, 1977.

Regulatory Guidance for Control of Volatile Organic Compound Emissions from 15 Categories of Stationary Sources, EPA-905/2-78-001, April, 1978.

Air Pollution Control Technology Applicable to 26 Sources of Organic Compounds, U.S. EPA, May 27, 1977.

A Study of Vapor Control Methods for Gasoline Marketing Operations, PB-246-088, Radian Corporation.

Reliability Study of Vapor Recovery Systems at Service Stations, EPA-450/3-76-001, March 1976.

Technical Support Document, Stage I Vapor Recovery At Service Stations, Draft, Illinois Environmental Protection Agency.

1972 Census of Retail Trade, Area Statistics, U.S. Department of Commerce, Bureau of the Census.

Hydrocarbon Emission Control Strategies for Gasoline Marketing Operations, U.S. EPA, Contract No. 68-01-4465, September, 1977, Draft.

Design Criteria For Stage I Vapor Control Systems Gasoline Service Stations, U.S. EPA, Research Triangle Park, North Carolina, November, 1975.

Mr. Kenneth H. Lloyd, EPA, Research Triangle Park, North Carolina.

Mr. Vic Rasheed, Greater Washington/Maryland Service Station Association.

Survey of Gasoline Tank Vehicles and Rail Cars, EPA Contract No. 68-02-2606, Draft, November, 1968.

Cost Data-Vapor Recovery Systems at Service Stations, PB-248-353, September, 1955.

Human Exposure to Atmospheric Benzine, EPA Contract No. 68-01-4314, October, 1977.

Systems and Costs to Control Hydrocarbon Emissions from Stationary Sources, PB-236-921, EPA, September, 1974.

Revision of Evaporative Hydrocarbon Emissions from Stationary Sources, PB-267-659, August, 1976.

17.0 THE ECONOMIC IMPACT OF IMPLEMENTING RACT FOR USE OF CUTBACK ASPHALT IN THE STATE OF GEORGIA

This chapter presents a detailed analysis of the impact of implementing RACT for use of cutback asphalt in the non-attainment counties in the state of Georgia. Presently, only twelve counties in Georgia are classified as non-attainment areas. They are: Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Fulton, Gwinnett, Henry, Paulding, Rockdale and Muscogee (Columbus). The impact of RACT in these counties is investigated in five sections as follows:

- Specific methodology and quality of estimates
- Industry statistics
- The technical situation in the industry
- Cost and hydrocarbon reduction benefit evaluations for RACT requirements
- Economic impacts

Each section presents detailed data and findings based on review of the RACT guidelines, previous studies of the use of cutback asphalt, interviews and analysis.

17.1 SPECIFIC METHODOLOGY AND QUALITY OF ESTIMATES

This section describes the methodology for determining estimates of:

- Industry statistics
- VOC emissions
- Control of VOC emissions
- Cost of controlling VOC emissions
- Economic impact of emission control
- Data quality

for the use of cutback asphalt in Georgia.

17.1.1 Industry Statistics

Industry statistics on the use of cutback asphalt were obtained from the U.S. Bureau of Mines. Sales in tons were avalaible for 1977. The value of shipments was calculated by applying an average unit price of 36 cents per gallon.

17.1.2 VOC Emissions

VOC emissions from the use of cutback asphalt in Georgia were calculated by multiplying the emission factors for cutback asphalt by the number of tons of asphalt used. The emission factor for slow cure asphalt is 0.078 tons per ton, for medium cure asphalt 0.209 tons per ton, and for rapid cure asphalt 0.20 tons per ton.[1]

17.1.3 Process for Controlling VOC Emissions

The process for controlling VOC emissions from the use of cutback asphalt is described in "Control of Volatile Organic Compounds from the Use of Cutback Asphalt," EPA-450/2-77-037, and "Air Quality and Energy Conservation Benefits from Using Emulsions to Replace Cutbacks in Certain Paving Operations," EPA-450/12-78-004. Interviews were conducted with asphalt trade associations, asphalt producers, and government agencies to gather the most up-to-date information on: costs for cutback asphalt and asphalt emulsions, the feasibility of using emulsions in place of cutback asphalt and the associated cost implications. Other sources of information were "Mineral Industry Surveys," U.S. Bureau of Mines; "Magic Carpet, the Story of Asphalt," The Asphat Institute; "Technical Support for RACT Cutback Asphalt,"

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[1] "Control of Volatile Organic Compounds From Use of Cutback Asphalt," EPA-450/2-77-037, p. 1-3.

State of Illinois; "World Use of Asphalt Emulsion," paper by Cyril C. Landis, Armak Company, "A Brief Introduction to Asphalt and Some of Its Uses," the Asphalt Institute; and "Asphalt: Its Composition, Properties and Uses," Reinhold Publishing Corporation.

17.1.4 Cost of Vapor Control

The costs for control of VOC emissions from the use of cutback asphalt are incurred by using emulsions in place of cutback asphalt. These costs include:

- Changes in equipment for applying emulsions in place of cutback asphalt
- Training of personnel to work with asphalt emulsions in place of cutback asphalt.

Additionally, if every state incorporates the RACT guidelines, additional plant capacity to produce asphalt emulsions would have to be created.

Costs were determined from analyses of the studies listed in the previous section and from interviews with asphalt trade associations, government agencies and producers and users of cutback asphalt and emulsions. These differential costs of replacing cutback asphalt with asphalt emulsions, were then extrapolated to the non-attainment counties in the state.

17.1.5 Economic Impacts

The economic impacts were determined by examining the effects of conversion to emulsion asphalts on: the costs of paving and road maintenance; the price of cutback and emulsion asphalts; the supply and demand for these asphalts; the employment of workers in end-use application; and on labor productivity in end-use applications.

17.1.6 Quality of Estimates

Several sources of information were utilized in assessing the emissions, cost and economic impact of implementing RACT for the use of cutback asphalt. A rating scheme is presented in this section to indicate the quality of the data available for use in this study. A rating of "A" indicates hard data (i.e., data that are published for the base year); "B" indicates data that were extrapolated from hard data; and "C" indicates data that were not available in secondary literature and were estimated based on interviews, analyses of previous studies and best engineering judgment. Exhibit 17-1, on the following page, rates each study output listed and the overall quality of the data.

EXHIBIT 17-1
U.S. Environmental Protection Agency
DATA QUALITY

Study Outputs	A Hard Data	B Extrapolated Data	C Estimated Data
Industry statistics	●		
Emissions		●	
Cost of emissions control		●	
12 county costs of emissions			●
Economic impact		●	
Overall quality of data		●	

Source: Booz, Allen & Hamilton Inc.

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17.2 INDUSTRY STATISTICS

This section presents information on the cutback asphalt industry, statewide statistics of cutback asphalt use, and comparison of cutback asphalt consumption to the statewide value of wholesale trade. A history of the use of cutback asphalt is also discussed. Data in this section form the basis for assessing the technical and economic impacts of implementing RACT in Georgia.

17.2.1 Industry Description

The cutback asphalt industry encompasses the production and use of cutback asphalt. Cutback asphalt is one product resulting from the refining and processing of asphalt from crude oil. Cutback asphalt is produced from refined asphalt and petroleum liquids at an asphalt mixing plant. It is then stored in tanks or loaded into tank trucks and sold to the end users, primarily state highway organizations and construction contractors.

17.2.2 Size of the Cutback Asphalt User Industry

This report addresses the size of the cutback asphalt user industry in Georgia. Although some cutback asphalt may be produced in Georgia, the production industry is not the focus of this study since RACT requires control of the use of cutback asphalt. Thirty-four thousand and one hundred-ninety tons of cutback asphalt were purchased in Georgia in 1977 at a value of $3.2 million. An estimated 12,821 tons of cutback asphalt worth $1.2 million were sold in the 12 non-attainment counties. The value is based on an estimated average price per gallon of $0.36.

Though the uses of cutback asphalt in Georgia are well documented, hard data on the number of employees involved in cutback paving operations are not currently available. Still, it is possible to make a reasonable estimate of the number of employees based on data found in the Department of Commerce County Business Patterns. It is estimated that in the 12 non-attainment counties approximately 325[a] people are engaged in operations where cutbacks can be used.

17.2.3 Comparison to Statewide Economy

The value of shipments of cutback asphalt to the statewide value of wholesale trade in Georgia is less than 0.05 percent.

17.2.4 Demand for Cutback Asphalt

In the 1920's and 1930's, the increasing sales of automobiles stimulated highway construction. The need for low cost pavement binders which provided weather resistance and dust free surfaces became apparent during this building cycle. Cutback asphalts emerged to fill this need. After World War II, the sale of cutback asphalts remained at an almost constant level. Since 1973, the use of cutback asphalt has decreased. Exhibit 17-2, on the following page, shows national sales from 1970 to 1976 of cutback asphalt, asphalt cement, and asphalt emulsions.

17.2 Prices of Products and Costs of Usage

Historically, cutback asphalts have been up to 10 percent more expensive per gallon than asphalt emulsions. In recent years, this differential has been negligible; however, in the past two years the historical price disadvantage has begun to reemerge.

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[a] In the non-attainment counties approximately 3,250 people were employed in highway and street construction. It is assumed that the number of people employed in cutback and emulsion applications is proportional to the 3,250 people. The factor of proportionality is the ratio of 1977 state sales of cutbacks and emulsions to 1977 state sales of all petroleum asphalts and road oils. At an estimated 10 percent, employment is approximately 325. At the state level, the 10 percent ratio implies a labor force between 500-999. See: County Business Patterns 1976: Georgia, U.S. Department of Commerce CBP-76-12, 1978, p. 3.

EXHIBIT 17-2

U.S. Environmental Protection Agency

HISTORICAL NATIONAL SALES OF ASPHALT CEMEMT, CUTBACK ASPHALT AND ASPHALT EMULSIONS

YEAR	ASPHALT CEMENT Use of (000 of tons)	ASPHALT CEMENT Percent of Total	CUTBACK ASPHALT Use of (000 of tons)	CUTBACK ASPHALT Percent of Total	ASPHALT EMULSIONS Use of (000 of tons)	ASPHALT EMULSIONS Percent of Total	TOTAL Use of
1970	17,158	72.7	4,096	17.4	2,341	9.9	23,594
1971	17,612	73.8	3,994	16.7	2,275	9.5	23,821
1972	18,046	74.2	3,860	15.9	2,399	9.9	24,305
1973	20,235	74.8	4,220	15.6	2,585	9.6	27,040
1974	19,075	77.4	3,359	13.6	2,208	9.0	24,642
1975	16,324	75.7	3,072	14.2	2,197	10.1	21,593
1976	16,183	75.3	3,038	14.2	2,254	10.5	21,474

Source: U.S. Bureau of Mines

The comparison between cutbacks and emulsions is somewhat different when one looks at quantity requirements. Though technically interchangeable in many applications, it is typically the case that more emulsion must be applied than cutback for an identical task. This is because emulsions have a lower asphalt content than cutbacks on a per gallon basis. Estimates on quantity conversions (substitutability) range from one-to-one to one-to-two in favor of cutbacks depending on the type of emulsion and the given application.

However, in terms of average cost of usage, currently, price and quantity differentials tend to be offsetting. Thus the cost of usage should be approximately the same.

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[a] Interview materials from The Asphalt Institute, College Park, Maryland

[b] Ibid. Contentions that the price/per mile of emulsions is cheaper than oil based asphalts are currently being made. Though true, the contention is misleading because the comparison is between hot mix asphalts and emulsions in overlay applications. Cutbacks are not used in overlay applications.

Source: Booz, Allen & Hamilton, Inc.

17.3 THE TECHNICAL SITUATION IN THE INDUSTRY

This section presents information on the use and production of asphalt. The sources and characteristics of VOC emissions from the use of cutback asphalt are then described and are followed by estimated statewide VOC emissions from the use of cutback asphalt; the VOC control measures required by RACT, and the VOC emission control procedure for use of cutback asphalt in Georgia.

17.3.1 Asphalt: Its Production and Uses

Asphalt is a product of the distillation of crude oil. It is found naturally and is also produced by petroleum refining. In the latter instance, the crude oil is distilled at atmospheric pressure to remove lower boiling materials. Nondistillable asphalt is then recovered from selected topped crude by vacuum distillation; oil and wax are removed as distillates; and the asphalt is left as a residue. Asphalts can be produced in a variety of types and grades ranging from hard brittle solids to almost water thin liquids. The type of asphalt produced depends on its ultimate use.

Asphalt is used as a paving material and in a wide range of construction applications. The cutback and emulsion asphalts that are the object of RACT legislation are paving materials used primarily in spraying and cold mix patching operations. For further information on asphalt production and use the reader is referred to: A Brief Introduction to Asphalt and Some of its Uses, The Asphalt Institute, 1977.

17.3.2 Sources and Characteristics of VOC Emissions From the Use of Cutback Asphalt

Hydrocarbons evaporate from cutback asphalts at the job site and at the mixing plant. At the job site, hydrocarbons are emitted from equipment used for applying the asphaltic product and from road surfaces themselves. At the mixing plant, hydrocarbons are released during mixing and stockpiling. The largest source of emissions, however, is the road surface itself. In Georgia, cutback asphalt is used in the construction and maintenance of secondary roads throughout the state.

It is the petroleum distillate (diluent) in the cutback asphalt that evaporates. The percentage of diluent that evaporates depends on the cure type.

The evaporating diluent in the three types of cutback asphalt constitutes the following percent of the asphalt mix by weight:

- Slow cure—25 percent
- Medium cure—70 percent
- Rapid cure—80 percent.

17.3.3 Statewide and Non-Attainment Area Emissions

Total emissions from the use of cutback asphalt in Georgia during 1977 are estimated to be 7,070 tons. In non-attainment counties approximately 2,660 tons of VOC were emitted. But given permitted RACT exemptions on cutback curtailment, only 1,460 tons will be subject to control.[a] See Exhibit 17-3 for details.

17.3.4 RACT Guidelines and the Implications of Their Implementation

Presently, the State of Georgia is preparing draft legislation on the use of cutback asphalt which will be modeled after the RACT guidelines.

The RACT guidelines specify that the manufacture, storage and use of cutback asphalts may not be permitted unless: long life storage is necessary; application at ambient temperatures below 50°F is nececcary; or application as a penetrating prime coat is necessary.

Given these exemptions, general experience with asphalt emulsions in several regions of the U.S. indicates that emulsions are adequate substitutes for cutbacks.[b] Moreover, the same equipment that is used to apply cutback asphalt can be used with asphalt emulsions after minor modification. The few changes necessary to replace cutback asphalt with emulsion asphalt are as follows:

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[a] Representatives of the Georgia Department of Transportation have indicated that RACT exemptions could account for 45% of current cutback usage.

[b] It is reported that emulsions cannot be applied in the rain. This is also true for rapid and medium cure cutbacks.

EXHIBIT 17-3
U.S. Environmental Protection Agency
ESTIMATED HYDROCARBON EMISSIONS FROM USE OF CUTBACK ASPHALT IN GEORGIA

	Sales[a] of Cutback Asphalt (000 Tons)			Estimated Hydrocarbon Emissions in 1977 (000 Tons)				Estimated Non-Exempted Hydrocarbon Emissions in 1977 (000 Tons)
	Rapid Cure	Medium Cure	Slow Cure	Rapid Cure	Medium Cure	Slow Cure	Total	
State	11.97	22.22	0	2.44	4.64	0	7.07	
12 Non-Attainment Counties[b]	4.49	8.33	0	.92	1.74	0	2.6	1.460[c]

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[a] Source: U.S. Department of Energy, Bureau of Mines

[b] Sales in the 12 non-attainment counties are assumed to be proportional to total state sales. The factor of proportionality is the fraction of the state population living in the 12 counties.

[c] 55 percent of emissions are from non-exempted cutbacks. See footnote (a) to section 17.3.3.

Source: Booz, Allen & Hamilton Inc.

- Retrain employees on the use of asphalt emulsions.
- Modify cutback asphalt equipment to accomodate asphalt emulsions, including:
    - Providing new nozzles on the distributor truck which applies the asphalt
    - Adjusting the pumps which apply the emulsion
    - Cleaning equipment prior to using emulsion
- Create emulsion plant capacity to meet the increased demand
- Provide asphalt manufacturing facilities with venting for steam.

17.4 COST AND HYDROCARBON REDUCTION BENEFIT EVALUATIONS FOR RACT REQUIREMENTS

Costs for using asphalt emulsions in place of cutback asphalts are presented in this section. Each cost item is discussed, quantified, and then the total cost is calculated in the non-attainment areas.

17.4.1 Costs Associated With Using Asphalt Emulsions in Place of Cutback Asphalt

The information on the costs of using asphalt emulsions in place of cutback asphalt was gained from interviews with asphalt trade association members, asphalt manufacturers, and from analysis of existing studies on asphalt.

Costs to users of cutback asphalt who must convert to emulsions are primarily those expenditures associated with retraining personnel and making minor equipment modifications. The existing price/gallon advantage accruing to emulsions is approximately offset by the quantity advantage accruing to cutbacks (in terms of required asphalt content and comparitive durability). Put differently, expenditures on materials should remain approximately constant, but those on capital and labor should increase as users convert to asphalt emulsions.

The most significant cost to the user will be for retraining personnel in the methods of asphalt emulsion application. It is estimated that these training costs are $300 per person including the cost of supervision for the training session.

Modification of trucks used in applying asphalt consists of replacing nozzles at a cost of $5 per nozzle. An average truck is equipped with 30 nozzles; therefore, the cost per truck would be $150. Other equipment costs include adjusting pumps and cleaning equipment before asphalt emulsions can be applied, and these are considered to be minimal.

Total user costs are assumed to be incurred on a one time basis. Minor equipment costs are generally not capitalized but are expensed in the accounting period in which they are incurred. The paragraph which follows shows total costs to the non-attainment counties for converting from the use of cutback asphalt to asphalt emulsion.

17.4.2 Extrapolation to the Industry in the Non-Attainment Counties

Converting from cutback asphalts to asphalt emulsions in the non-attainment counties is estimated to cost $55,575. This translates into $38.06 per ton of hydrocarbon emissions reduced. A summary of these costs is given in Exhibit 17-4 on the following page.

EXHIBIT 17-4
U.S. Environmental Protection Agency
COSTS IN GEORGIA FOR APPLYING RACT TO THE USE OF CUTBACK ASPHALT

Direct Cost Summary

Cutback asphalt used in non-attainment counties (tons per year)	12,800
Potential emissions reduction[a] from converting to use of emulsion asphalt (tons per year)	1,460
Retraining costs[b]	$31,200
Equipment modification costs[c]	$24,373
Total one-time costs	$55,575
One-time costs per ton of emissions reduced	$38.06
Annualized operating cost per ton of emission reduced	$ 0.0

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[a] Assumes 45% of cutback usage will be exempted.

[b] Retraining costs are calculated in two stages. First, it is assumed that the percent of the labor force unfamiliar with emulsion application will be roughly equal to a proxy ratio which relates sales of cutbacks to sales of cutback plus emulsions in 1977. Since the sales of cutbacks were 34,190 short tons and those of emulsions 71,761, the proxy ratio is about one-third. Second, this proxy is multiplied by the estimated total labor force (325) and the cost per person ($300).

[c] Representatives of national asphalt organizations have suggested that for every two workers there is approximately one distributor truck. This implies that 162.5 trucks will need modification at a cost of $150 per truck.

Source: Booz, Allen & Hamilton Inc.

17.5 ECONOMIC IMPACTS

This section discusses the economic impacts associated with applying RACT to the use of cutback asphalt in Georgia. The direct economic impacts include:

- User Cost—The estimated one-time cost of $55,575 distributed over 12 counties in Georgia is small compared to the $162,000,000 allocated for construction and maintenance in the fiscal 1978 state budget.
- Price—The prices of cutback and emulsion asphalts may be marginally affected by RACT to the extent that demand and supply shifts for both products are not offsetting. However, it is not RACT but rather the increasing cost of diluents used in cutbacks which will have the most decisive impact on price differentials in the future.
- Demand—If current usage patterns prevail through 1981 when RACT is scheduled for implementation, then the demand for cutbacks might fall off by 55% while the demand for emulsions rises by 21%.
- Employment—No change in employment is predicted from implementing RACT, although it will be necessary to retrain approximately 325 employees in Georgia on the use of asphalt emulsions.
- Productivity—Given appropriate retraining, worker productivity is not expected to be affected by handling more emulsion asphalts.

In addition to direct impacts there may also be indirect effects. Implementing RACT may cause a strain on current industry capacity to meet the increased demand for emulsion asphalts. To the extent that a supply-demand imbalance is inherent, it may be necessary for producers to invest in new plant capacity. Presently, it is anticipated that sufficient lead time exists for any supply-demand imbalance to be redressed. Insufficient data are available to quantify these potential costs in Georgia.

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Exhibit 17-5, on the following page, presents a summary of the findings in this report.

EXHIBIT 17-5(1)

U.S. Environmental Protection Agency
SUMMARY OF DIRECT ECONOMIC IMPLICATIONS OF IMPLEMENTING RACT FOR USE OF CUTBACK ASPHALT IN THE STATE OF GEORGIA

Current Situation	Discussion
Use potentially affected	In 1977, use of cutback asphalt was 34,190 tons statewide and an estimated 12,821 tons in non-attainment counties.
Indication of relative importance of industrial section to non-attainment county economies	1977 sales of cutback asphalt were estimated to be $3.2 million statewide and $1.2 million in non-attainment counties.
Current industry technology trends	Nationally, use of cutback asphalt has been declining.
1977 VOC emissions (actual)	7,070 tons annually statewide; 2,660 in non-attainment counties, 1,460 of which are non-exempted
Industry preferred method of VOC control to meet RACT guidelines	Replace with asphalt emulsions
Assumed method of control to meet RACT guidelines	Replace with asphalt emulsions

Affected Areas in Meeting RACT	Discussion
Capital investment in non-attainment areas	$0.06 million
Annualized cost in non-attainment areas	No changes in paving costs are expected.
Price	No changes in paving costs are expected.
Energy	14,100 equivalent barrels of oil saved[a]
Productivity	No major impact
Employment	No major impact

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[a] The saving accrues to manufacturer, not user. The total energy associated with manufacturing, processing and laying one gallon of cutback is approximately 50,200 BTUs/gallon. For emulsified asphalts, it is 2,830 BTUs/gallon. One barrel of oil equivalent is assumed to have 6.05 million BTUs, and one ton of cutback asphalt is assumed to have 256 gallons.

EXHIBIT 17-5(2)
U.S. Environmental Protection Agency

RACT timing requirements (1981) -	Long range supply of asphalt emulsions are expected to be available.
Problem area	Winter paving Short range supply of asphalt emulsions
VOC emission after RACT control	Net VOC emission reduction is estimated to be 1,460 tons annually
Cost effectiveness of RACT control	The cost is $38.06 per ton in the first year. In subsequent years the cost is zero.

__Source__: Booz, Allen & Hamilton Inc.

BIBLIOGRAPHY

Control of Volatile Organic Compounds from the Use of Cutback Asphalt, EPA-450/2-77-037, December 1977.

Air Quality and Energy Conservation Benefits from Using Emulsions to Replace Cutbacks in Certain Paving Operations, EPA-450/12-78-004, January 1978.

Mineral Industry Surveys: Asphalt Sales, Annual U.S. Department of the Interior, Bureau of Mines, Washington, D.C.

Magic Carpet: The Story Of Asphalt, The Asphalt Institute, College Park, Maryland.

Technical Support for RACT Cutback Asphalt, State of Illinois EPA.

"World Use of Asphalt Emulsion," paper presented by Cyril C. Landis, Armak Company.

A Brief Introduction to Asphalt and Some of Its Uses, The Asphalt Institute, College Park, Maryland.

Asphalt: Its Composition, Properties and Uses, by Ralph N. Traxler, Rheinhold Publishing Corp., New York, 1961.

County Business Patterns 1976: South Carolina, U.S. Department of Commerce, CBP-76-12.

Mr. Gladstone, Federal Highway Administration Statistics on State Highway Construction and Maintenance Expenditures.

Atmospheric Emissions from the Asphalt Industry, EPA-650/2-73-046, December 1973.

Energy Requirements for Roadway Pavements, The Asphalt Institute, College Park, Maryland, Misc.-75-3, April 1975.

Asphalt Hot-Mix Emission Study, The Asphalt Institute, College Park, Maryland, Research Report 75-1 (RR-75-1), March, 1975.

"Hot-Mix, Cutbacks and Emulsions" by Fred Kloiber, Natural Asphalt Pavement Association, Special Report, November 4, 1977.

Mr. Fred Kloiber, National Asphalt Pavement Association.

Mr. Steven Patterson, U.S. Bureau of Mines.

Mr. Charles Owens, Asphalt Institute.

Mr. Frank Kerwin, U.S. EPA.

Mr. Vaughan Marker, The Asphalt Institute, College Park, Maryland.

The Asphalt Handbook, The Asphalt Institute, April 1965.

Mr. Charles Maday, U.S. EPA.

Mr. Terry Drane, Emulsified Asphalt, Inc.